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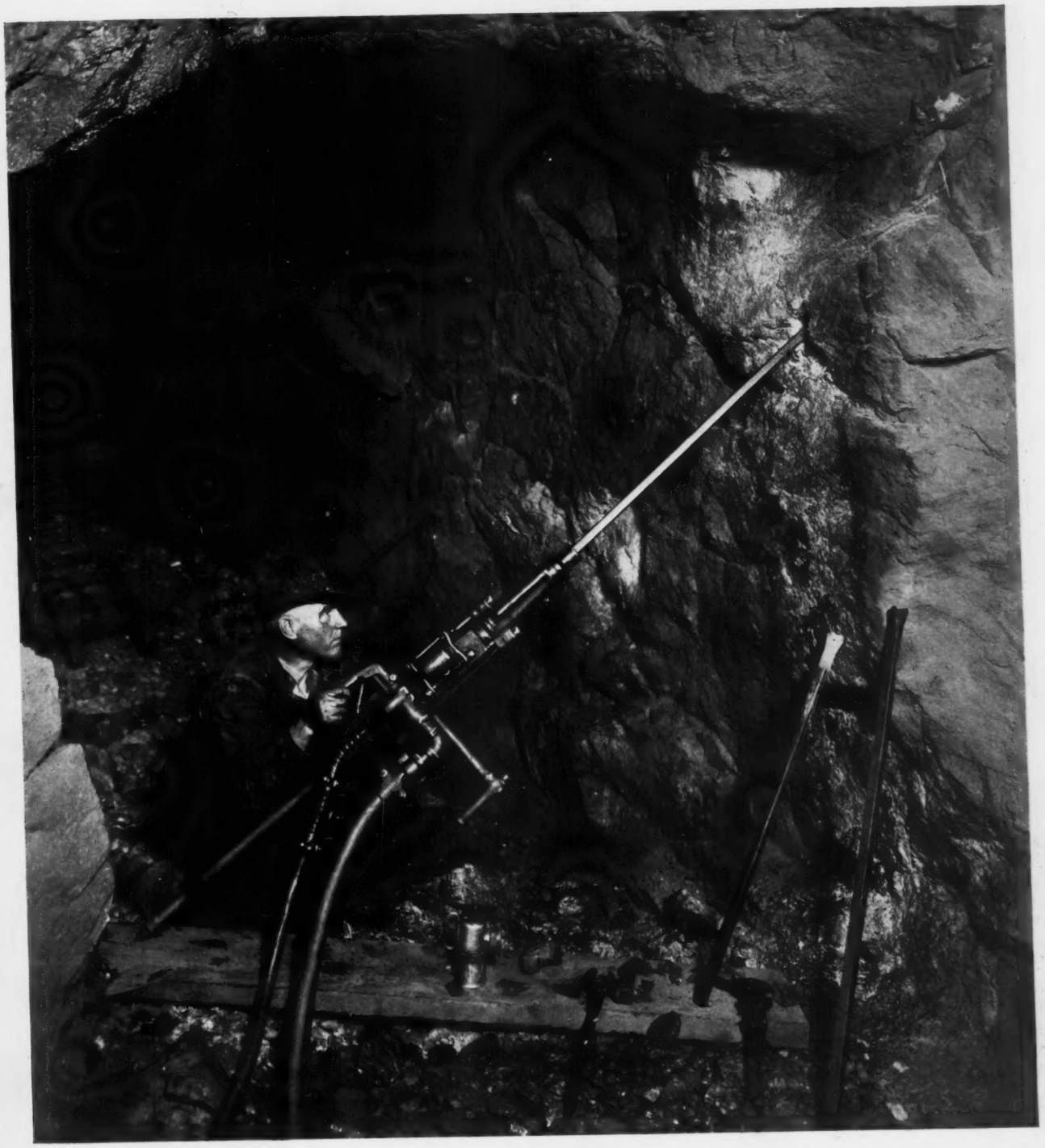
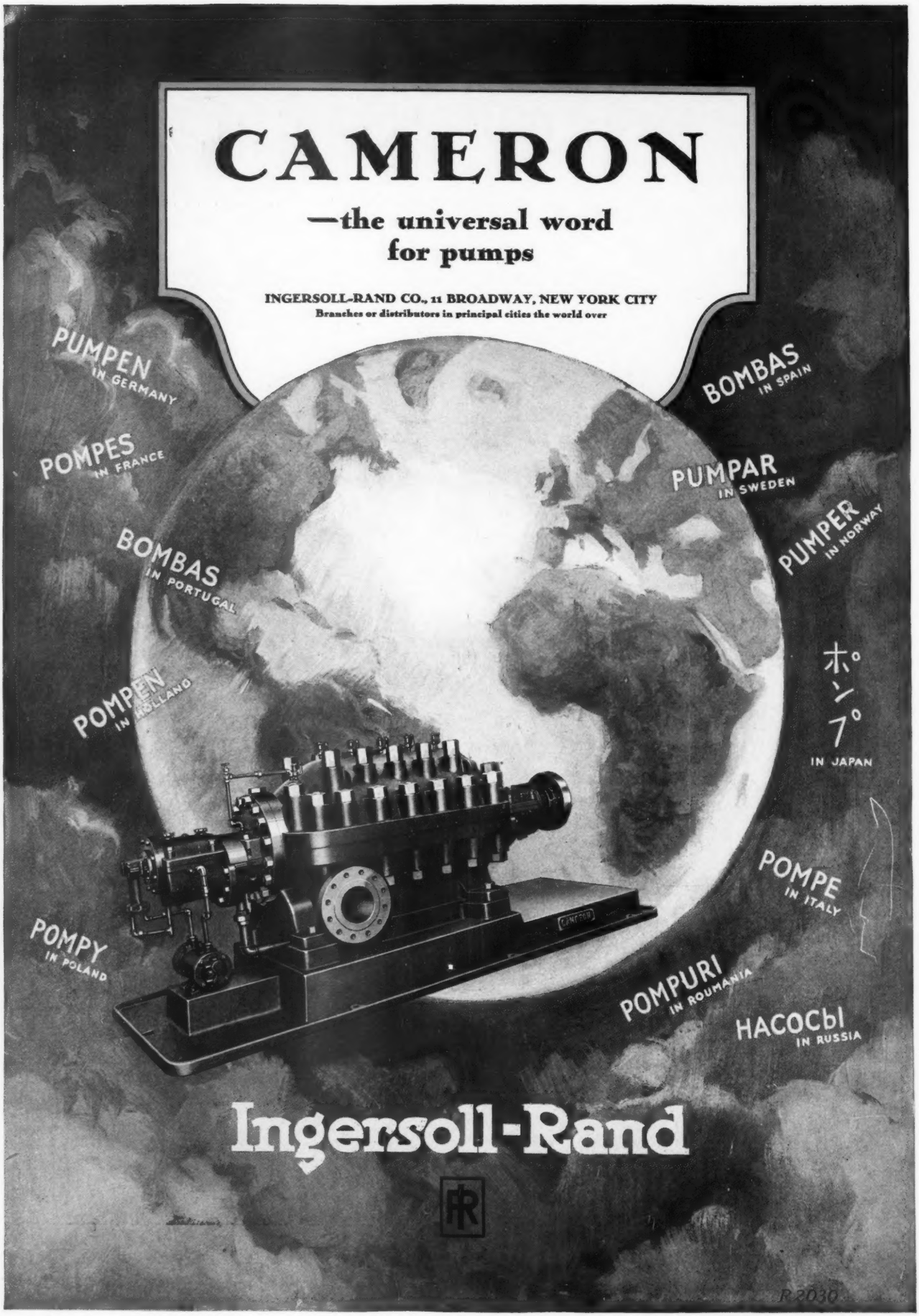


Underground at Butte

July 10, 1930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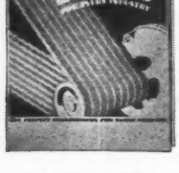

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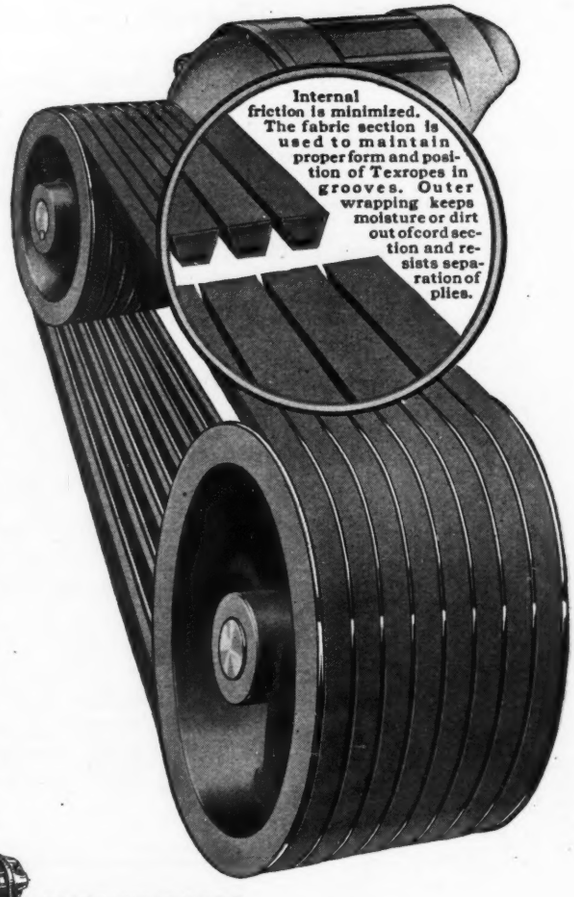
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ENGINEERING AND
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JOURNAL

A. W. ALLEN, *Editor*

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New York, July 10, 1930

Leadership in Human Affairs—a Phase of Engineering

AS THE IDEA of efficiency continues to displace that of mere performance, and as the need for the acceptance of increasing responsibility focuses attention on the capable and willing worker, so does dissatisfaction arise out of the inadequacy of the various definitions of an engineer that have been propounded since the first attempt was promulgated by the Institute of Civil Engineers, which depicted him as one whose characteristic was the directing of the great sources of Nature for the use and convenience of man.

The harnessing and utilization of the so-called forces of Nature is now an accomplished fact, with an established technique that is capable, of course, of continued improvement. The major opportunity for achievement lies in the betterment of the technique in the handling of men; and in this respect the engineer should prove as capable as he is supposed to be in the control of the inanimate.

These comments were prompted by a thoughtful and inspiring address delivered by Dr. George Otis Smith, director of the United States Geological Survey, at the Montana School of Mines, on June 6. Human engineering, he averred, offers the greatest opportunity for service. He recalled a remark by a distinguished executive who had said that his difficulty was to find engineers who possessed qualifications indicating leadership in human affairs—men to officer his army of graduates from the technical schools. What was most needed was an appreciation of the fundamentals of human relationships, with a keen and sympathetic view of life.

Doctor Smith urged his hearers to observe and study social economics along with the practice of technical engineering. "Our interest in copper or oil or coal is, after all, an interest in men and women and children, and the most successful mining development should be that which makes for a permanent community as well as a secure investment," he added. Continuing, he maintained that the "Wise utilization of a natural resource includes provision for a high standard of living in a community that is more than a camp where men toil. Your engineering should be socially sound," he urged, "if it is to help in making a land where healthy and happy children live, and where good citizenship as well as mineral wealth is produced. Far better than quick development and large profit is the slowly expanding mine, which, when it reaches an economic size, still has reserves that promise profitable operation through a span of years sufficient to guarantee not only continued returns to the stockholders, but—what means far more to this Western country—continued work for those who, under modern ideas of democratic society, should be regarded as preferred shareholders in any enterprise."

Historical Summary

Engineering and Mining Journal was founded in 1866 as the *American Journal of Mining*, the title being changed in 1869. Publications absorbed comprise: *Coal and Iron Record* (1875); *The Mining Review* (1877); *The Polytechnic Review* (1879); *Mining and Metallurgy* (1902); *The Mining Magazine* (1906); *Mining and Engineering World* (1917).

The following have served as editors in chief of *Engineering and Mining Journal* and its predecessor publication: G. F. Dawson (1866-67); R. W. Raymond (1867-74); R. W. Raymond and R. P. Rothwell (1874-89); R. P. Rothwell, (1890-1901); D. T. Day (1901-02); T. A. Rickard (1903-05); W. R. Ingalls (1905-19); J. E. Spurr (1919-27); A. W. Allen (1927-).

Engineering and Mining Journal was consolidated with *Mining and Scientific Press* in 1922, as *Engineering and Mining Journal-Press*. The title was changed to *Engineering and Mining Journal* in 1926.

The editorial staff of *Engineering and Mining Journal* comprises: A. W. Allen, editor; E. H. Robie, George J. Young, A. H. Hubbell, associate editors; W. N. P. Reed, H. D. Keiser, S. D. Strauss, J. B. Huttl, assistant editors; H. H. Wanders, market editor.

Issued twice each month

Intelligent Use of Acid-Resistant Alloys

ACID-RESISTANT ALLOYS, so generally helpful to the hydrometallurgist, sometimes fail under operating conditions, even where preliminary tests have given promise of satisfactory service. A superficial observer may condemn the material and discard the equipment without a thorough investigation as to the reasons for failure, the result, in some instances, of faulty application and construction, and not of any inherent defect in the alloy. One piece of equipment that gave excellent service in the evaporation of a corrosive liquid was destroyed in a few hours after a piece of iron, a tool, had been accidently dropped into the apparatus. Small pieces of metal of inferior quality, used in fittings and connections, have had disastrous effects upon acid-resistant equipment. The explanation—galvanic action—apparent to those who have made a study of corrosion, is often overlooked by the average operator.

The possibility of catalytic or accelerated chemical action should not be disregarded. An acid-resistant alloy, with copper as the main component, in one instance failed under conditions it was specified to meet. Investigation disclosed that a strongly oxidizing action was responsible. Copper, as is well known, dissolves readily even in dilute acid under such conditions.

Equipment made from corrosion-resistant material is unavoidably expensive. Care should be exercised to insure satisfactory and maximum service. An intelligent technical study of the problem, and close supervision of operating conditions, are essential to insure full benefit of the advantages that modern alloy technique is offering in combating corrosion.

The Progressive Operator and the Inventor

INVENTIVE INGENUITY does not wait upon good times. The inventor is born, not made, despite liberal appropriations for research. Wrote Elmer A. Sperry shortly before his death, which occurred recently, quoting the head of the Eastman laboratories at Rochester: "When you get your hands on an inventor, freeze on to him. He finds a path around or across when the research man has been stopped."

The old saw that necessity is the mother of invention is only partly true: the inventor follows his natural bent for devising, even though a need may not be apparent. Whether the industrial cycle be at a high point or a low one, an inward urge compels him to seek new ways of doing things, better materials and instruments with which to do them. Invention is independent of economic conditions. History has shown that poverty and privation, not wealth and facilities, have provided the atmosphere for great basic inventions.

The mine operator has busy times or dull times, according as production is stimulated or discouraged by the condition of the market. When metal prices fall, his thoughts turn first to the possibility of lowering costs. In new or modified process and equipment, or in reorganization of methods, lies the answer, if there be one.

Thus far, in the present year, much new equipment of ingenious conception and design has been announced. A new idea embodied in cars and locomotives, themselves of a novel kind, will facilitate the building of dumps and stockpiles. Valves, of all types, large and small, that operate in places remote of difficult of access, may now be controlled from a convenient central station, with accuracy and ease. Even the long-established method of operating the Belgian furnace for smelting zinc concentrate has been improved by the inventor's ingenuity: A machine has been devised that will supplant manual labor in charging the zinc retorts. The boiler-feed pump for high-pressure work has been developing so rapidly that the chief designer of a prominent manufacturer recently referred to a model only six months old as being "out of date." The photo-electric cell now performs many tasks as if by magic, in its greatly multiplied industrial applications. Other new or newly applied electrical devices of many sorts and for many purposes are steadily appearing in almost bewildering variety. In this profusion of invention the operator should find much that is worthy of serious attention. Money wisely spent on improved equipment, will come back in lowered working costs.

Is Publicity Concerning Ore Discoveries Justified?

AN EXECUTIVE of a small Western copper company recently confessed reluctance to furnish information on results of development work in the mine. "Our business is to find ore," he declared. "And when we find it, we are merely conducting our business. I see no reason for having the fact published as news, particularly because most people consider each ore-strike a potential bonanza."

Strong arguments can be advanced in favor of this attitude. Responsible mining men do not want their industry considered as merely offering opportunity for speculation—as a mere toy in the hands of fate. In the case of the particular company involved, discoveries of additional ore are comparatively common. Its properties are situated in a district where three or four years' reserve of ore is the maximum economic limit. Development work must be continually maintained. Failure to find new ore where expected is much more a matter of comment than is its discovery.

To refrain from publishing information concerning new ore discoveries undoubtedly prevents the suspicion that public interest—and therefore public purchase of stock—is being artificially stimulated. But, analogously, to refrain from publishing such information may lead to the belief that officials are taking advantage of facts known only to themselves. If one is a cynic concerning human virtues, the one attitude is as logical as the other.

What is the answer? *Engineering and Mining Journal* believes it has been found. Several British mining companies—notably the Witwatersrand and Broken Hill companies, Mount Lyell, Burma Corporation, Santa Gertrudis, and Mexican Corporation—publish at regular intervals complete data on all development work. Public interest in a stock can be unduly stimulated only if certain information is published and other information withheld. The cost of publishing complete reports is undoubtedly one reason why so few are issued in the United States. In the case of large companies, with

many mines included in the holdings, such publications would be hardly practicable. Few stockholders would wade through the resultant masses of accumulated data. But large companies are not affected by new ore disclosures to the extent that small companies are. A new ten-foot orebody of six per cent copper ore at Butte would hardly cause anybody to buy or sell Anaconda Copper shares. In the case of the small or the medium-sized mining company, however, *Engineering and Mining Journal* feels that the expense of publishing complete data on development work is fully justified by the assurance that it gives of the integrity of the company and its management.

Staggered Rest Days Among Industrial Workers

INDUSTRY, in this country and abroad, is facing many serious problems. France stands almost alone in having no unemployed—using the word in the generally accepted sense. Elsewhere the supply of labor exceeds the demand. The increasing use of labor-saving machinery is creating technological idleness, and a world-wide depression operates against the possibility of taking up the slack by the creation of new wants and an increase in the manufacture and sale of the so-called luxury products.

By a process of elimination of other less feasible possibilities, attention is being directed to the opportunities in the direction of the shorter working week. The Soviet plan of continuous operation, with one rest day in five for each worker, taken in group succession, possesses obvious mechanical and technical advantages that will insure smoothness of operation and low production costs. The apparently insuperable obstacle that stands in the way of any consideration of this plan beyond the confines of the U.S.S.R., however, is its disregard of the seventh day in each week, observed by most other industrial nations as a day when avoidable labor is taboo.

Mr. H. K. Norton, in a recent issue of the *Forum,* makes an interesting proposal. He has endeavored to arrange a compromise, paying due regard to religious susceptibilities and taking into account the progressiveness of Mr. Ford, and the action of the Soviet in securing continuity of output. He suggests, for normal industrial operations, uninterrupted production during the six customary weekdays, with Sunday still reserved. Two days off per week would be allowed to each employee, but the week-day vacations would be staggered from Monday to Saturday, enabling workers to have one week day off in addition to the regular Sunday freedom.

The Norton plan is a suggestion in the right direction. Its advantages are obvious. Continuous operation over six days would result, instead of over five or five and one-half days. More workers would be employed. Shopping during week days by employees would be spread over the six days, instead of being concentrated in one afternoon—Saturday—as at present. Provision for amusement and recreation would be utilized every day, instead of on one and one-half days; and, finally, the growing congestion of the roads on Sundays would be stemmed, if not considerably reduced. In fact Sunday, under the Norton plan, might even become a day of rest.

New Refrigerant May Be Used To Cool Mine Air

FLUORO-CHLORO-METHANE, a refrigerant, may prove useful for cooling mine air, the American Chemical Society says, in announcing it as a new development. The substance is a clear, white liquid which boils at eighteen degrees Fahrenheit. Besides having desirable engineering characteristics for refrigeration, it is non-toxic and non-inflammable. Optimistic, the Society expects it to replace ammonia, sulphur dioxide, and other refrigerants now in use, though not immediately. Two years will be required before production can be started on a commercial scale.

Such news should interest the operator afflicted with hot, uncomfortable stopes and headings. But the refrigerant to be used is only one factor in the problem of cooling mine air. Other matters are involved: Shall the air be cooled on the surface before it is sent underground; or shall the equipment be installed in the mine, and, if so, where? If at the collar or at any station in the shaft, the air must be distributed to the working places, where wanted, without absorbing so much heat en route that on reaching them it is no longer cool. And no matter where the cooling equipment be placed underground, extensive excavation may be required. Heat removed from workings, moreover, must be sent to surface or to some distant point. Mine waters, if available in sufficient volume, may be used as the conveying medium; otherwise another solution to this phase of the problem must be sought.

Without going into the thermodynamics of heat removal and transfer, these points suffice to show that the problem of cooling mine air is in general far from easy. It may, in cases, be solved only at considerable cost. Looking ahead, however, the engineer can imagine a day when the operator will voluntarily seek the aid of science and invention in bettering conditions for the miner in this respect. The motive that actuates him may be the desire to get more work for wages paid, in which case the cost of cooling will be carefully considered. But, if the motive be to avert or meet demands of the employee that cannot be refused, cost will be a secondary consideration. In both cases, the better the refrigerant is, the better will be the outcome to all concerned.

The pioneer air conditioning plant recently put into operation at Morro Velho, described in a recent issue of *Engineering and Mining Journal,* will probably be duplicated under similar, deep-mine conditions. Perhaps a scheme involving the use of a portable unit equipment possessing the limited function of cooling the air in its immediate vicinity will prove the most widely serviceable. New economies, now unthought of, may attend the application of fluoro-chloro-methane to the cooling problem. But the difficulties undeniably will be great.

For still another reason the new refrigerant should be of interest to at least one branch of the mining industry. If found widely applicable, its manufacture will furnish a new outlet for fluorine minerals, such as cryolite and fluorspar.

Methods of Treating Madagascar Graphite

A hill-side graphite deposit

William Thompson

IN MADAGASCAR, graphite is found in gneiss in the same formation as mica; in Siberia, in granulites; and in Bohemia in gneiss, mica schists, or crystalline limestone. When masses of graphite are found before complete decomposition, the mineral can be exploited much easier and more economically than when diffused in the rock as it is more generally mined. In Ceylon; in Canada, whose principal center of production is the Buckingham district of Quebec; and in the United States, where deposits are found in Georgia, Pennsylvania, and New York, graphite occurs in two forms: dry crystals and in an amorphous state, consisting of slippery particles. Each has its distinct uses. Only the crystalline is indigenous to Madagascar.

A related mineral is sometimes confounded with graphite; it abounds in the Alps of Italy, France, Austria, and Hungary, and also in Brittany, the Central Plateau of France, and the Pyrenees. It is improperly designated as *amorphous* graphite. According to M. de Pritzbner, a recognized authority, this product is "anthracite which under the influence of orogenic changes has undergone such compression that the graphitization of a part, or the whole, has caused it to resemble the purer element." The mineral thus metamorphosed possesses only a few of the qualities of graphite and cannot always be substituted for it. The French savant proposes to call this, "graphitoide."

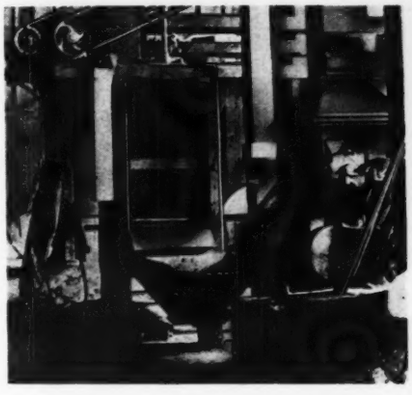
The Malgache crystals of Madagascar are principally utilized in making metallurgical crucibles. They are found in strata at a uniform depth, in reddish earth produced by the decomposition of the gneiss. After the clearing of the forest and removing the surface soil, the graphitic earth is taken to the wash sheds, where the first operation, called *debourbage,* or cleaning, takes place. Usually the mass does not yield more than 10 per cent of graphite mixed with feldspar, from which the potassium has disappeared, leaving only clay, quartz reduced often to sand, crystals of mica, and particles of iron. The mass is shoveled into the cleaning basin, from which it passes through a series of wooden troughs, which separate first the sand, then the crystals, and finally other residue. The last troughs are covered with metallic nettings, the mesh being of various sizes. These successive siftings, made under primitive sheds to protect the blacks from the sun and rain, so abundant in this tropical climate, result in yielding graphite of 45 to 60 per cent carbon. To secure a grade of 80 per cent it is necessary to eliminate other impurities such as iron, mica, and lime.

Dense forest vegetation must be cleared before the ground is mined

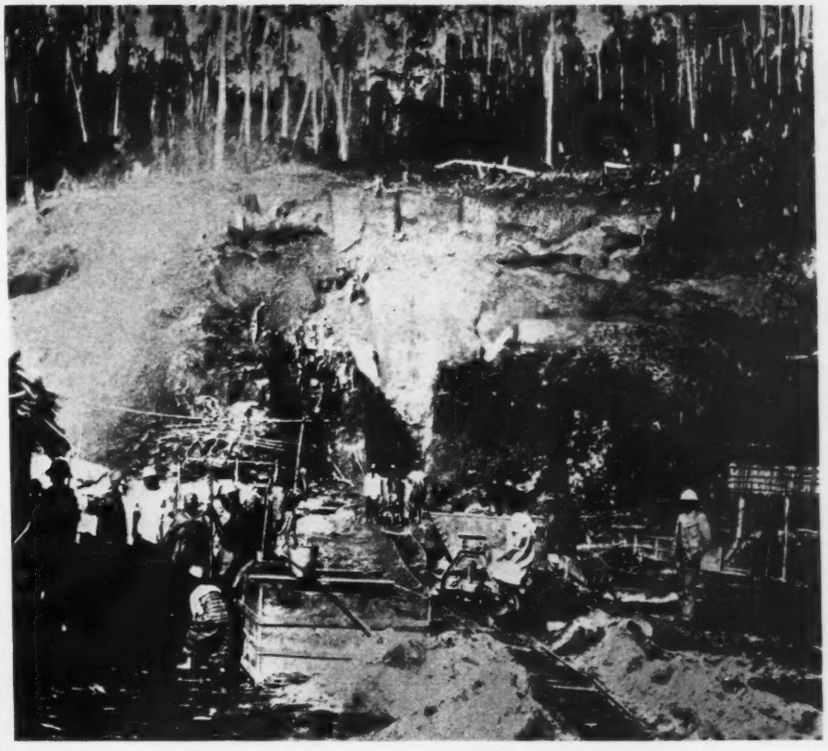
In coming from the wash sheds the mineral mass contains sand, graphite, and about 4 or 5 per cent of mica. To remove the sand it is delivered to the winnowers. The crystals fall in a vat from the winnow of the Malgache worker. In the Suberbie plant, and the establishments of the "Society of General Stores and Depots of Madagascar," these operations are performed mechanically. After cleaning, the graphite is dried, sorted by agitating sieves, and put through winnowing machines analogous to those employed in cleaning wheat.

Since 1917 the exporters, by preference, have bought the mineral washed by the natives, and it is refined either at Tananarive, the capital of Madagascar, or in France. According to the character of the soil, three or four tons of washed graphite produce a ton of the commercial product.

As the mechanical sifting does not eliminate the mica when the sizes of the crystals equal those of the graphite, the elimination of this impurity becomes a problem for the chemist. Although the laboratories which treat the graphitic mineral chemically guard their secret, M. de Pritzner, who is familiar with the industry, advises us that the use of petroleum or other greasy substances is necessary. The unrefined graphite, mixed with petroleum under certain conditions, detaches itself from the impurities, by floating. The first graphites shipped from Madagascar to Europe contained a large percentage of mica, which proved destructive to the cruciples. Of late, Madagascar has been producing a very high grade of graphite.



In a graphite mill at Anosible, Madagascar



Working graphite ground at Perinet, Madagascar

Graphitic minerals having 85 to 94 per cent carbon contain iron, and until recently it was not possible to eliminate it. The elimination of this impurity was also made with the aid of petroleum, but it is a very expensive process. There is, in addition, an electrical treatment, by which the graphites are given qualities which they lack, but this process has not yet been put on a commercial basis.

Some refiners in Germany, after soaking unrefined graphite in oil, subject it to a bath of boiling water. Following the boiling process the impurities fall to the bottom of the vat, the crystals remaining on the surface. This method was formerly employed at Nürnberg, Germany, but being a costly process, it has been abandoned, as the Ceylon product is cheaper.

The greasy graphites have more important and more varied uses than the crystals. They are used in the manufacture of pencils, lubricants, and molds for foundries and glassworks, and are also employed in electrical equipment. Canadian and Mexican greasy graphites can be used as they exist in nature, or require very little preparation, containing 92 per cent and even more carbon, but most graphitic deposits are not so rich and the product must be purified. Methods of refining amorphous graphites are not perfected sufficiently to enable low-grade deposits to compete with natural deposits containing a high percentage of carbon. In Bohemia, amorphous graphite of high density is obtained from low-grade deposits by treatment with carbonate of soda and heat. This chemical method, when tried in Madagascar, furnished an inferior product and has not been applied industrially in this French colony.

Huts of the Malgache graphite workers

Acheson artificial graphite is manufactured by submitting anthracite to the high temperature of an electric furnace. In the years immediately preceding the War, this product was employed as a lubricant, and also in the electric industry, because of its conductibility. It is prepared by heating with electricity anthracite containing no other impurities than silica and traces of alumina. The high temperature secures the partial disappearance of the silica and finally results in a pulverized mass of exceptional fineness containing 95 per cent of carbon. Although regarded as slightly inferior to the Ceylon, Acheson graphite is a formidable competitor for most uses, as the price is so much lower. Experiments by American and European technicians have been fairly successful in creating a good and cheap graphite lubricant.

Malgache exporters do not fear competition from these substitutes. In the Madagascar deposits are vast layers of crystalline graphite which can be easily extracted and can compete, in almost all the markets of Europe, with the mines of Ceylon. The World War stimulated the development of this industry in France's large African island. During the first year of the War 6,314,000 kg., or 13,891,044 lb., was produced. The maximum production during the War was 15,015,050 kg. After the War the maximum was reached, output totaling 4,049,888 kg.

Until 1914, France bought the Malgache graphites after they were purified in the United States, or Frankfort, Germany. The producers of Madagascar complained of the methods employed by certain foreign houses which bought the graphite directly from the exploiters and resold it in Europe. For example, first quality Malgache graphite, containing 90 per cent or more carbon, was sometimes sold under the name of "Ceylon graphite," reserving the Malgache label for an inferior quality which had been badly refined. French industrialists and merchants now buy from the producer, or demand a certificate of origin.

Novel Repairs Prolong Life of Large Air Compressor

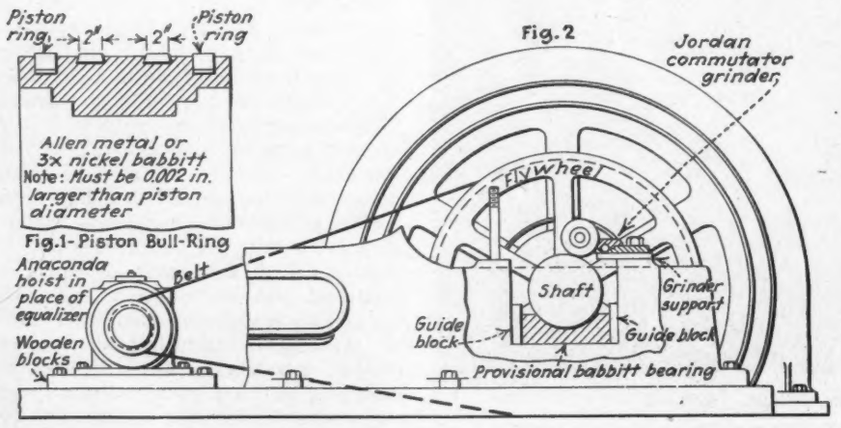
TWO innovations at the Butte & Superior Mining Company's Black Rock mine, at Butte, Mont., are, first, the method of increasing the life of the low-pressure cylinder sleeve of a large type PRE air compressor, and, second, the procedure employed in reconditioning the main shaft of the compressor, which had been badly grooved as a result of a burnt-out bearing. Both repairs were successful and a description of them follows.

Rapid wear of the cylinder bore is generally experienced on the low-pressure cylinder of large air compressors. The cause of this is not always faulty lubrication; rather it may be attributed to the heavy weight of the piston. For this reason, pistons of the built-up type, which have the advantage of weighing less, have been constructed in recent years. Furthermore, by using this type of piston, a reboring of the cylinder requires only a new bull ring and new piston rings, and permits the use of the same spider and follower plate. A second method is to provide a through piston rod, with an end slipper, to effect an even distribution of the piston weight between the crosshead and the end slipper. This method, however, is not applicable to compressors of the PRE type. The compressor at the Butte & Superior property was therefore fitted with a built-up piston, but even so the life of the cylinder sleeve never exceeded one year. Ultimately, the bull ring of the piston was provided with two grooves, as shown in Fig. 1, which were filled with Allen metal or 3X nickel babbitt and then turned down on the lathe to a diameter about 0.002 in. larger than the piston diameter. An excellent result was obtained by this alteration. Inspection of the cylinder after five years' continuous service disclosed little wear on the sleeve, and an adjustment of the piston was unnecessary.

Bearings will burn out, in spite of careful precautions. If a machine can be stopped promptly, the damage generally is slight. When "tin soldiers" are found in the crank box, however, a damaged shaft always results. A returning and regrinding of the shaft, in addition to a new set of bearings, is then necessary to repair the damage. This incurs considerable expense and loss of time, because the rotor and flywheel must be dismantled before the shaft can be placed in a lathe.

At the Black Rock mine, no lathe sufficiently large to accommodate the shaft of a PRE compressor was available; it was therefore necessary to devise other means to rectify the shaft in the least time possible. First, the connecting rods were disconnected, and the shaft was cleaned and smoothed off as much as possible. Then, the shaft was lowered onto a provisional babbitt bearing—care being taken, of course, to obtain a perfect alignment. Next, a Jordan commutator grinder was installed above the shaft, as shown in Fig. 2, the small motor or equalizer being removed and replaced by an Anaconda hoist. This arrangement permitted the shaft to be rotated slowly by means of a belt attached to the flywheel and the pulley of the hoist. After completion of grinding operations, a new set of bearings was made to fit the diameter of the reground shaft, and, when fitting them, the shaft was found to be uneven in several places. To remedy this, the compressor was run at a slow speed, and water mixed with Bon Ami was fed evenly into the bearing for about three hours. After this operation, the bearing was carefully washed out and cleaned before the final trial run, with oil as lubricant.

Details of repair to a Type PRE air compressor



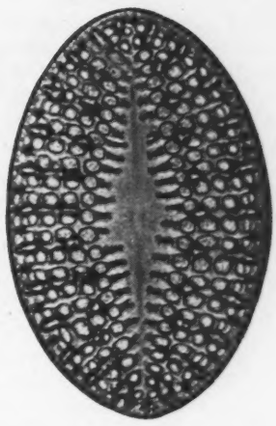
Porosity of Diatomite

G. Dallas Hanna

Paleontologist, Associated Oil Company, San Francisco, Calif.

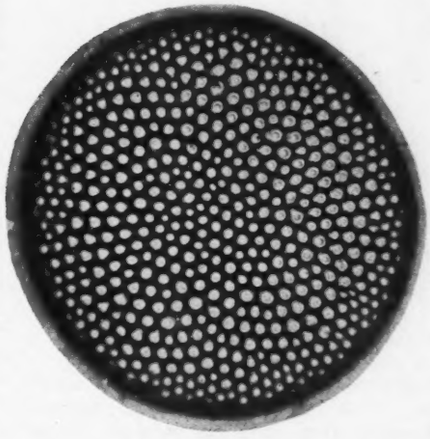
1. Cocconeis

2. Auliscus



3. Cocconeis

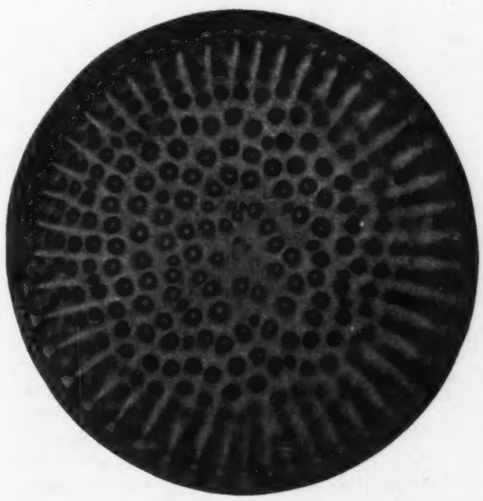
4. Coscinodiscus



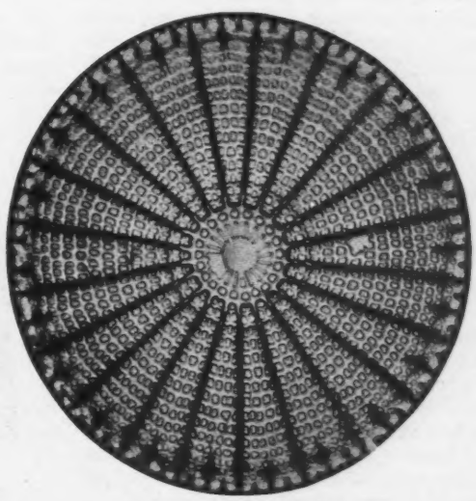
6. Coscinodiscus

THE impression seems to be general among engineers who deal with insulation and filtration problems that much of the efficacy of diatomite lies in the *"fact"* that these minute plants have extremely porous skeletons of silica. The apparent density of such earth is so low (*7* to *22* lb. per cubic foot) that the interspaces between the individual fossils have not been supposed to be sufficient to account for the great porosity. In the most recent publication (and incidentally a very thorough compilation relating to the economic uses of these fossil plants), Calvert made the following statements, among others, regarding porosity: "Altogether, diatomaceous earth is very porous. There are spaces between the fossil diatoms. Also, there are pores in the fossils themselves. There are several hundred pores, for example, in a single, large diatom of the species *Coscinodiscus rex,* of the shape of a saucer and of a diameter of about 90 microns." Calvert, Robert: "Diatomaceous Earth." Am. Chem. Soc., Monograph Series 1930, p. 219.) Also (on p. 43) it is stated concerning a certain deposit that, "when made into a thermal insulating brick, the frustules with the very fine pores give such thermal insulating power as partly to offset the conductance of the clay and other heavy impurities present, in comparison with other diatomaceous earths containing less clay but having larger pores in the fossil diatoms."

The literature shows that these or similar opinions are shared by many engineers. It therefore seems desirable to attempt to correct the fallacy because the markings so well known on the surfaces of diatoms are *absolutely not* pores. Those illustrated in the accompanying halftone reproductions have such markings, as do most of the other 10,000 known species. The ornamentation may be imagined to be beads or bosses as well as pores. Indeed, this matter was argued back and forth by an earlier generation of microscopists, and there are many publications on the sub-



5. Stictodiscus



7. Arachnoidiscus

ject. Finally, when lenses were so perfected that the so-called pores were often found to bear a secondary set of bead-like markings, the discussion was thought to be ended. It seems unfortunate that engineers at this late date should revive the misconception.

Ample proof of the continuity of the silica all over the surface of the fossil may be obtained by viewing a broken edge well magnified. Where the supposed "pore" is located, the silica is simply thinner. If a hole were there present it would inevitably happen sometime that a sponge spicule or a broken sliver of a diatom would project through; but it never does.

In the manipulation necessary to prepare such small objects for technical study it is customary to pick them up individually by means of an instrument known as a mechanical finger. Essentially this consists of a glass hair drawn out to a sharp point and so mounted that its motion is controlled by means of screws. If pores were present in the diatoms, these objects could be strung bead-like on the glass hair; but it cannot be done. No holes are present sufficiently large to be seen under the highest magnification.

Other groups of siliceous fossils are found in the marine diatom deposits, particularly the *radiolaria* and *silicoflagellata,* which do possess true pores in the skeletons. These can be strung with the mechanical finger with the greatest ease. But pores in diatoms—the idea was abandoned a half a century ago.

The illustrations here presented are from photographs of characteristic diatoms from the Miocene shales near Monterey, Calif. None of the markings seen, not even the large eye spots of Fig. 2, are pores; all are merely thin or raised places in the silica of the skeletons. The various specimens are classified as follows: (1) *Cocconeis;* (2) *Auliscus;* (3) *Cocconeis;* (4) *Coscinodiscus;* (5) *Stictodiscus;* (6) *Coscinodiscus;* (7) *Arachnoidiscus.* All of the photographs from which the pictures were made were enlarged from 250 to 500 diameters.

Mechanical Float Switch

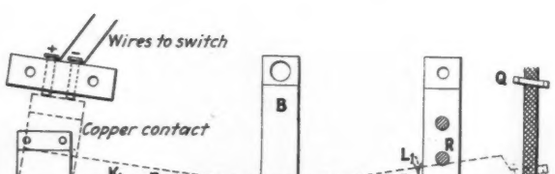


Fig. 1—Sketch of mechanical float switch used at Page mine, Idaho

A FLOAT-TYPE mechanical switch of the novel design shown in the drawing has been developed by Charles Fite, master mechanic of the Federal Mining & Smelting Company's Page mine in northern Idaho, for use on a water tank 3,000 ft. distant from the pump. It consists of two lever arms, *K* and *L*. The arm *K* has one end perforated and rotates on a pin *N*, the other end carrying a contactor, *M*. The arm *L* has one end perforated and rotates on the same pin as *K*, the other end having an opening through which passes the cable *O*. Each lever arm is provided with a pin *P* which projects on both sides of the arm. The two arms are kept in place by tension springs stretched between the pins *P*. The cable *O*, provided with a float and traveling through a pulley and guides, and having a counterbalance on the other end, passes through an opening in a lever arm *L*. Clamps, *Q*, on the cable are adjusted according to the depth of water required in the tank.

In using this switch, both arms are set in a straight line, the springs keeping them so. The clamps *Q* are set at the required height. Assumedly, the pump is delivering water to the tank. The water level is rising, and with it the float, causing the cable *O* to travel upward in the guides. The lower clamp *Q* presses against the arm *L*, pushing it upward and deflecting it from the straight line. Dotted lines on the drawing show the resulting condition of the lever arms. As soon as this condition occurs, the double spring attached to pins *P* contracts, pressing contactor *M* against two terminals of the electric circuit, causing a red light to flash and stopping the pump automatically. The lever *L* is stopped from swinging too far by an adjustable pin *R*.

When the water level in the tank gets to the point where the pump must be started again, the float falls correspondingly, causing the upper clamp *Q* (set previously at the desired water level) to push the arm *L* down, causing the springs to act on the lever arms, and bringing the contactor *M* against the lower pair of electrodes. This closes the circuit, flashes the white light, and starts the pump.

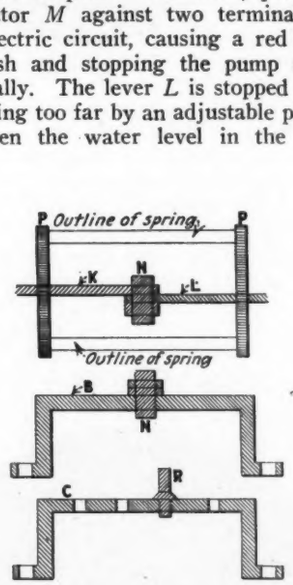
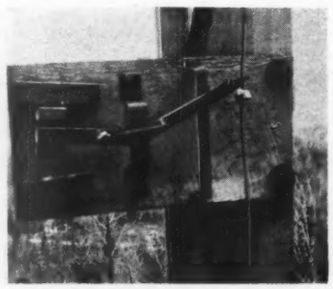


Fig. 2—Details of float switch shown in Fig. 1



Float switch shown in Figs. 1 and 2. Tank is filled and switch has stopped pump

The Unappropriated Public Domain

Alford Roos

Vanadium, New Mexico

INASMUCH as President Hoover has recently raised the question of the advisability of turning over to the several Western public land states all the residual, open, unappropriated, unreserved federal lands, it seems timely to consider what effect this will have on the mining industry in those states. The governors, at the President's request, have already appointed delegates to meet in Washington, and some decision is to be expected. Mining interests should give the matter careful thought.

Thanks to an unaccountable apathy on the part of the mining fraternity, the Stock-Raising Homestead Act was passed in 1916, much to the injury of miners and prospectors. No serious cry was raised against its passage. Let not history repeat itself! By this act we departed radically from our traditional policy of unity of title in lands. For the first time we promulgated the doctrine of severance of mineral and surface title. A deed may now issue from the government covering the surface rights, and at the same time another deed or patent may issue covering title to the minerals therein. This theory of severance, so foreign to tradition and precedence in our agrarian laws, is especially incongruous as now applied, in that the rights and guarantees given to the mine locator by much older laws have never been repealed. Certainly a serious conflict has arisen between the two interests.

BEFORE 1916 only those lands not known to contain valuable minerals were open for homesteading, and, when patent issued under the 160-acre act, minerals as well as surface were included. The lands turned over to the states were those classified and designated as non-mineral. In addition to other lands, they generally included Sections 2, 16, 32, and 36, classified as School Sections; but when these were found to be mineral lands, the states have selected lieu sections in place of them. In most cases the deeds from the government expressly reserve and exclude mineral rights. However, more recently, legislation has been enacted which in certain cases gives the several states mineral title to school sections.

Great blocks of the public domain are being turned over to the states, after which they are often found to be in the possession of stockmen. For instance, how many are aware that as late as Jan. 25, 1927, Congress passed a law (Public No. 520, 69th Congress) turning over to the several states, with full title, including mineral, rights to those school sections in place and known to be mineral in character. In addition to Florida, which is partly affected, thirteen Western states benefit by this act. They are: Arizona, California, Colorado, Idaho, Montana, Nebraska, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

Among withdrawals of the domain whereby public lands have recently been turned over to a state was one authorized by Congress in 1928 in an act turning over to New Mexico a quarter of a million acres. There is something questionable about this particular turn-over, although its avowed purpose was altruistic. It was brought about by the activities of three astute politicians who have benefited personally through an enormous "commission." The land itself already appears to have been taken over by certain cattle barons.

How is the public domain administered by the Land Office and the Department of the Interior? Especially, how is the Stock-Raising Homestead Law interpreted when in conflict with mining claims? A typical example may be considered in which mineral and surface conflicts have gone by appeals through the General Land Office and on up to the Secretary of the Interior for ruling.

This is the Hurliman decision, described in Vol. 51 of L.Ds[1] and decided on appeal by E. C. Finney on Oct. 31, 1925. The salient features are: One John Egan had located the Jack Oak lode mining claim in June, 1914, had built a good residence on it as well as several substantial outbuildings, had taken his residence on the claim, was doing his annual assessment work and some development work, and was in open and notorious possession, having lived on or near the claim for 28 years. Then came one Helen Hurliman, long afterwards, be it noted, and made an additional homestead, which was allowed by the Land Office in March, 1922, and amended to include the land covered by the Jack Oak claim in May, 1923, after which she appealed to the Secretary of the Interior from a decision of the Commissioner of the General Land Office which upheld Egan's claim. Government inspectors testified to taking assays which carried values in gold, silver, copper, and zinc to the value of $2.21 (metal values were very low then), and Warren Prosser, U. S. Deputy Mineral Surveyor and mining engineer, testified to seeing veins of yellow oxidized material that might be gold; he also testified that the veins would have to carry 30 per cent zinc to be acceptable at the smelter. Evidently the mine had been a shipper, and all agreed that there were two veins carrying amounts of gold, silver, copper, and zinc.

IT HAS been settled in the Federal Court decision of Thallman v. Thomas (111 Fed. 277) that "a valid claim of unappropriated public land cannot be instituted while in possession of another who has a right to its possession under another and earlier lawful location." Again and again this doctrine has been upheld. Since Egan was certainly prior and in possession, let us see how the department naïvely got around this long-established usage. Egan's rights seem to be further strengthened by the federal courts having held that "it is well settled that land in the actual possession and occupancy of one under color of title of claim of right is not subject to entry by another" (Jones v. Arthur, 28 L.D. 235 and the famous Atherton v. Fowler case, 93 U. S. 513, and the Krueger v. U. S. 246 U. S. 69 and many others); yet all this was of no avail for him; indeed, this long line of decisions would seem to confirm him in his rights, since he had valuable minerals and was in occupancy and possession and doing his assessment work. But the department dispossessed him.

Helen Hurliman, the Department said, did not "violently intrude" on miner Egan, and since it has long been the policy of the government that when a later claimant comes along and applies for a legal subdivision, and enters on a part of such subdivision not occupied by the prior claimant (Egan), the later claimant (Hurliman) can file his declaratory statement and obtain certificate of entry and be allowed to re-

[1]Decisions of the Department of the Interior Relating to Public Lands; 52 volumes.

cover the whole tract, including the part occupied by the older claimant. If this seems too preposterous for the reader to believe, see page 263 L.D. 51. This reasoning was supported by the department citing two California cases. It was not supported by federal decisions, but only by those of certain state courts.

But since Egan had minerals and had done assessment work, the department was not yet "out of the woods," so it contended that Egan did not work steadily on his claim—only sporadically; and that he did outside assessment work at times to keep the "pot boiling"; also that the smelters penalized for zinc; that Egan and his predecessors had been unable to show a profit, and that the mine was not paying; also that the rumors of a custom mill coming into the district which would be able to eliminate zinc could not be assured—that it was merely rumor; hence the Jack Oak mining claim was a "nullity."

Another case may be considered which differs from the Hurliman case in that the homestead was an agricultural entry, claiming the mineral rights as well as the surface. This is very recent and has not appeared in the published Land Decisions. I was called as an expert witness on both sides and prepared the papers which initiated the contest. It is the Coffey v. Davis case in which Coffey was the miner and Davis the homesteader. Coffey's claim, the Magnolia, was an old, old claim going back many years, and on which the annual assessment work had been done faithfully and legally at all times. This was not questioned. He had built a residence on it, fenced it and put up other buildings, and was in notorious occupancy and possession. But a few rods from his end line is a mine that was producing a good grade of lead-zinc, which vein struck into Coffey's claim, the latter being largely covered with wash. A short distance to the north is the Chino Copper mine, and many other smaller mines are near.

Davis plastered an agricultural homestead (the region is dry desert land) over the claim, claiming exclusive possession of surface and mineral. Coffey protested, contested and went to court. The homestead won; the case went to appeal, and again the homestead won. Coffey was ordered off and so it ended. Davis established a residence and store just outside the sidelines of the mining claim, as in the Hurliman case, and was not "violent" about it; so he won. Coffey has had to remove his fences and buildings. Patent has now issued, I understand, to the homestead covering surface and mineral.

So, as the public domain is administered, not even the mineral rights are protected from homesteading in some cases. Let us now see what the conditions might be under the several state laws in the administration of the land.

The first and most outstanding thing is that there will be an absolute establishment of the doctrine of severance of mineral and surface in our public lands under the laws of the several Western states. As it is now, under federal jurisdiction, this doctrine is not in full force, since it is still possible for one to locate a mining claim on federal lands, and in due course, after making a "discovery" and finding mineral of merchantable grade, and spending not less than $500 in improving and developing the claim and paying the government $5 an acre, to secure a patent on it (although there are certain other costs and the patent is subject to inroads).

As for the status of lands under state ownership, especially with respect to mining, each of these states has its own code, rules, and regulations governing the administration of its public lands; as might be expected, there is no uniformity. The following bears witness:

Nevada has never enacted or adapted any laws for leasing, selling, or disposing of state mineral lands. F. A. Lotz, surveyor general of the state, has just written to me to the effect that the state is not supposed to have any such lands.

California can as quickly be disposed of. Under Article 14 of Rules and Regulations relating to state lands, it is provided that mineral leases may be had under the same rules that govern oil leases; that is, a two-year lease with a one-sixteenth royalty to the state. Mineral rights may not be sold. However, the whole matter of leasing mines is apparently closed by the later Assembly Bill 35, Chapter 536, passed May 28, 1929, which carries the stipulation that after Sept. 1, 1929, "no application to prospect for oil or gas or minerals other than oil or gas shall be received . . . or granted." From this, one may gather that from now on, no one can lease, buy, or prospect for minerals belonging to the State of California.

In Colorado, mineral leases may be obtained, but no mineral rights can be sold outright. The leases vary widely as to terms and conditions. Only 640 acres may be had in one application. Rates of royalties and other terms depend on a number of things. There seems to be nothing fixed or uniform in the regulations.

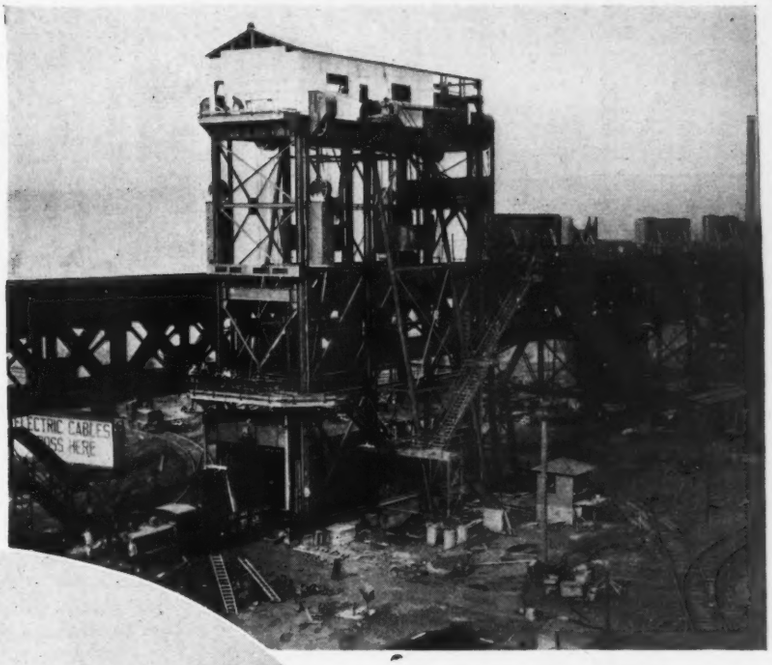
In Arizona, mineral leases may be obtained, but may not be sold. Leases provide that not less than $5 per acre per year be spent on development work. This applies to the first or "Prospector's Lease." If, fortunately, the prospector finds ore, he can remove but 50 tons under this lease; afterward he must surrender the lease and is then eligible for a "Development Lease" at 5 per cent royalty, non-transferable without the consent of the state, and subject to other restrictions. Don C. Babbitt, State Law Commissioner, writes that no form of contract is so far necessary.

New Mexico, with the 12,200,000 acres received from the government, presents a situation that is again different. Although mineral rights may not be sold, they may be leased and thus: One initiates his rights by making a regular mining location, as in the case of a federal placer claim, causing it to conform to sectional lines. He then files and records it, digs a 10-ft. hole, and must make a "discovery" therein—it specifies that the discovery must consist of a "mineral," and since it goes no further it is presumed that if one discovers some feldspar or calcite or mica, it will suffice. He is now eligible for a 90-day prospector's permit. Next he applies for a lease in which it is required that he submit a map made by a licensed surveyor; also to furnish an appraisement by two disinterested parties and an affidavit as to his discovery of some rock; then, he must pay a minimum fee of $25, in addition to $6 he has already paid for filing fees. This $25 fee is for the first year's rental and must be paid each year. After that he is "sitting pretty" with a five-year non-transferable lease at 5 per cent royalty. All of which is very complicated. A grazing lease may be given on top of the mineral lease. In all cases the mineral leaser must also put up a $2,000 bond. It is not required that he do further work on his claim, however, and that is something to be said of it. After finding some rock he may sit supine for five years, merely paying a minimum of $25 a year.

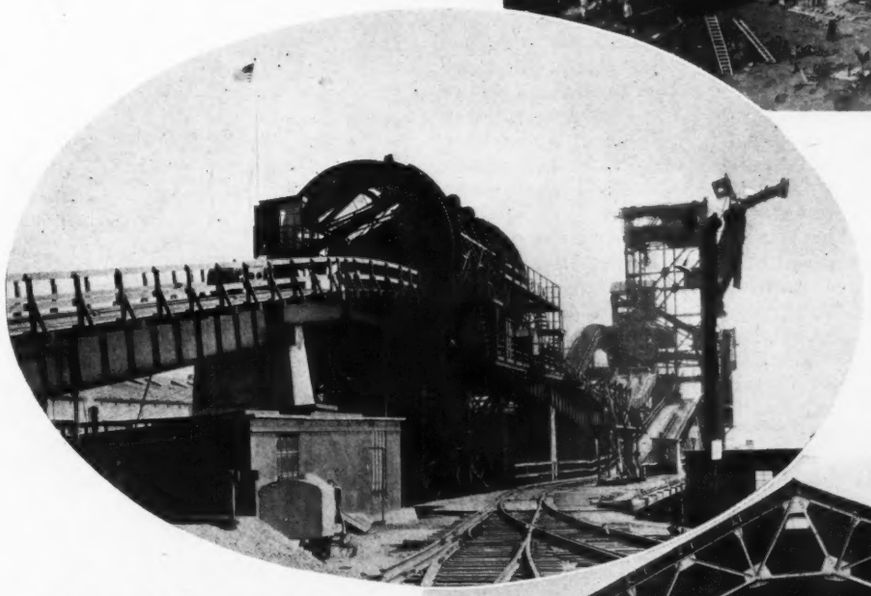
One can see that there is much to be desired in either case—whether the lands remain under federal jurisdiction or under that of the states; but taking it all in all, in choosing between two undesirable conditions, it is better that the unappropriated public domain remain under its present status. If the turnover were made, as suggested, the Land Office could not be abolished, at least for many years, since so many land matters are already intricately involved which would take years to clear up. It is unnecessary to point out how difficult, if not impossible, it would be to prospect and develop new mines on public state lands under the regulations of the several states as they now stand. Conditions are more susceptible of improvement under present conditions.

Desirable changes and reform in the existing mining laws could more easily be brought about. Few but believe that these things should be done. Certain it is that the Stock-Raising Homestead Act was an error and should be repealed. Much evil would be eliminated were the Department of the Interior restricted and tied down to a closer and less broad interpretation of the law.

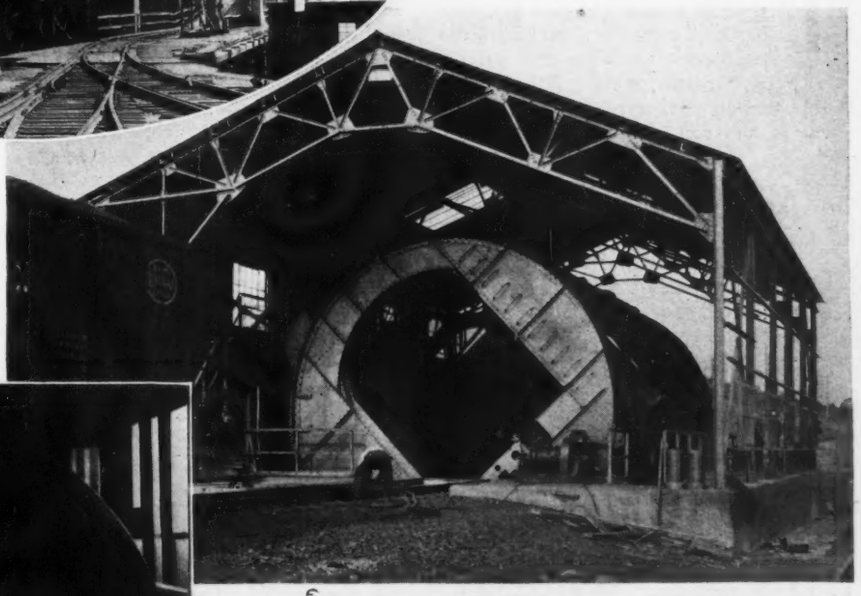
HANDLING LOADED CARS

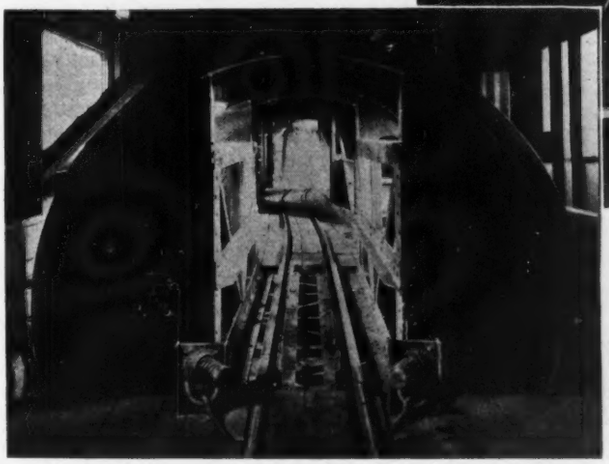


Different methods for handling loaded cars with a minimum of labor are pictured in these four interesting illustrations. For use at its James H. Reed power station, where tracks are on two different elevations, the Duquesne Light Company has installed the 200-ton freight-car hoist pictured above



For dumping purposes at its yards in Baltimore the Western Maryland Railroad Company uses the lifting car dumper and conveyor shown above. The Pittsburgh Coal Company uses a 50-ft., two-clamp dumper, illustrated at the right, in handling coal at its Champion preparation plant, Steuben Pike, Pa.





Park Utah operate the single-car tipple shown at the left for handling silver-lead-zinc ore at the portal of the Keetley tunnel, near Park City, Utah. Wellman Engineering, formerly Wellman-Seaver-Morgan, furnished this installation and the other pictured above

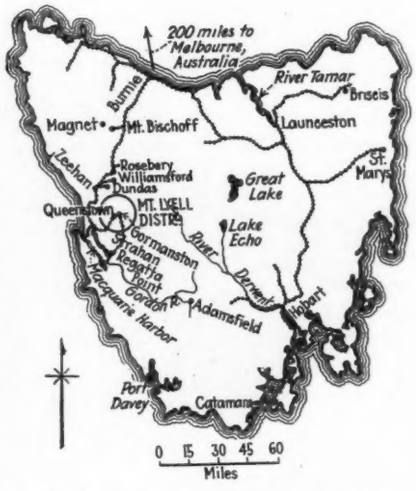
Metallurgical Operations at Mount Lyell, Tasmania

Sketch map of Mount Lyell district and vicinity

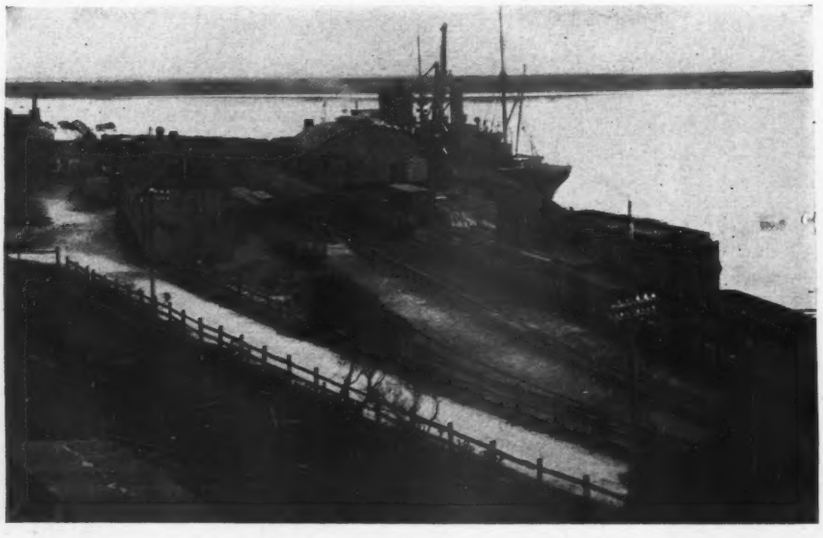
THE MOUNT LYELL mining field is situated in the western part of Tasmania, about 15 miles northeast of Macquarie harbor. From Strahan, at the northern end of this harbor, connection with Queenstown, in the center of the district, is made by the Mount Lyell Railway. About 20 miles from the sea is the West Coast Range of mountains, which parallels the coastline and varies from 2,000 to 4,000 ft. in height. Mount Lyell and Mount Owen are included in this range, and the ore deposits of the field are situated along the intervening ridge.

In general, the district is extremely rugged and mountainous, and covered with extensive forests and heavy undergrowth. The climate is decidedly wet, the West Coast of the island differing markedly in this respect from the rest of Tasmania. The average annual rainfall is about 110 in., reaching 150 in. on the neighboring mountain plateaus, and is distributed over a large number of days throughout the year. Except for frequent high winds, however, the climate is mild, averaging about 55 deg. F.

The outcrop of the original Mount Lyell mine was discovered in 1885 by prospectors in quest of alluvial gold. As the hematite and limonite outcrop was gold-bearing, the property was originally worked as a gold mine. In 1891, however, the ore occurrence was recognized as an immense copper deposit. A company was formed and a railway constructed from Strahan to Queenstown.



Sketch map of Tasmania, showing situation of Mount Lyell district



Railway terminus and wharves at Regatta Point

Smelting works were erected, production of blister copper commencing in 1896; and operations have been maintained continuously since that time. The original Mount Lyell Company absorbed the North Mount Lyell Company in 1903, and has since acquired all the other properties in the district. From a mining standpoint, the most important rocks of the district are schist and conglomerate. Extensive faulting is a feature of the district, and the ore beds occur along the Great Lyell fault, where these two rocks are brought sharply into contact.

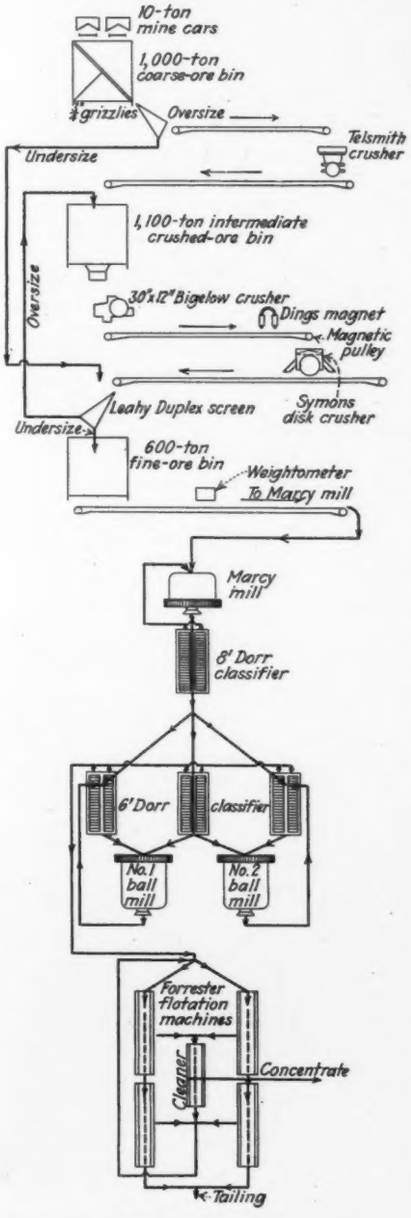
The Mount Lyell mine was actively worked as a copper deposit from 1896 until 1922, when pyritic smelting was discontinued and operations at the mine were suspended. Current ore production is obtained from the North Mount Lyell and the Lyell Comstock mines.

This article was prepared from data courteously supplied by Mr. R. M. Murray, general manager, Mount Lyell Mining & Railway Company, Ltd., Queenstown, Tasmania.

The former was discovered in 1897, during the course of road construction. Ore from North Mount Lyell consists of bornite, chalcopyrite, and pyrite, in a gangue of dense gray quartzite; the copper content ranges from 4 to 5 per cent. The Lyell Comstock mine, which is situated north of Mount Lyell, was purchased in 1912, and has since been extensively developed. Production from the property totaled 16,322 tons for the fiscal year ended Sept. 30, 1929. The ore consists of chalcopyrite and pyrite, in a gray quartzitic schist, the copper content averaging about 3 per cent.

Ore concentration was begun in 1916, in an experimental flotation mill erected for the treatment of Lyell Comstock ore. Later, the lower-grade North Lyell ore was treated, and since 1922, when pyritic smelting was discontinued, all the company's siliceous ores have been concentrated by flotation methods.

Surface workings and Crown Lyell shaft at the North Mount Lyell mine



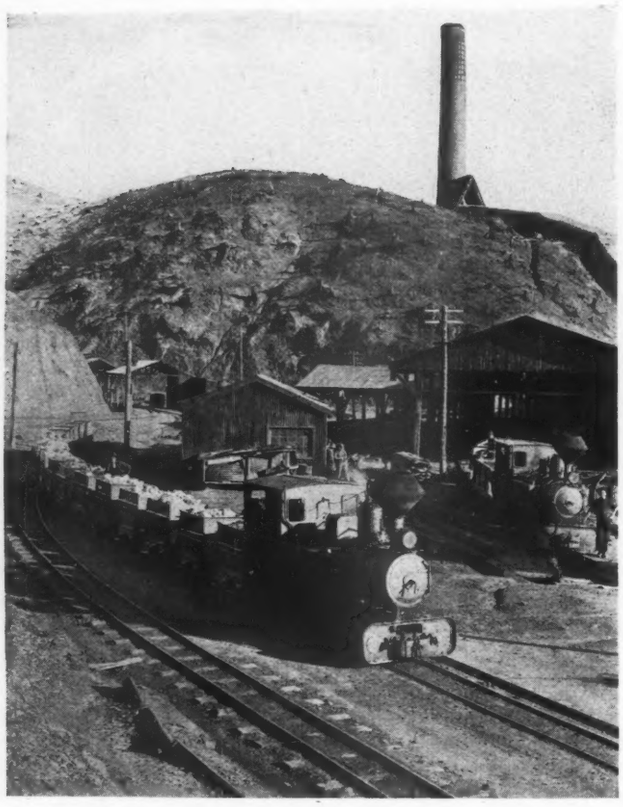
New flow sheet of the Mount Lyell all-flotation concentration plant

As shown in the accompanying flow sheet of the concentration plant, the mine ore is dumped into a 1,000-ton coarse-ore bin, from which it passes over grizzlies, 7 ft. long and spaced at ¾ in. The oversize from the grizzly is conveyed to a Type K Telsmith crusher, which has a capacity of 100 to 150 tons per hour in reducing the ore to a size that ranges from 2½ to 4 in., as a maximum. This crusher is belt-driven by a 75-hp. motor, and is equipped with manganese-steel wearing faces. The product is conveyed to a crushed-ore bin of 1,100 tons' capacity, which serves as an intermediate storage. The ore is discharged from the bin by three reciprocating plate feeders, 4 ft. 6 in. long and 4 ft. 4 in. wide, and passes to a 30x12-in. Bigelow jaw crusher, which is driven by a 50-hp. motor and equipped with manganese-steel jaws. On passing through this crusher, the ore falls onto a conveyor that passes under a 24-in. Dings double-pole electromagnet, where tramp iron in the ore is removed. The conveyor discharges into a 48-in. Symons vertical-shaft disk crusher, which has manganese-steel disks and is driven by a 70-hp. motor. This crusher has a capacity of 50 tons per hour and delivers a ½-in. product.

From the Symons crusher, the ore is conveyed to a Leahy duplex vibrating screen, where it joins the undersize from the grizzlies. Oversize from the Leahy screen is returned to the crushed-ore bin, the undersize passing into a 600-ton fine-ore bin. A conveyor, which passes over a weightometer, delivers the discharge from the fine-ore bin to a Marcy ball mill, operating in closed circuit with an 8-ft.x23-ft. 4-in. Dorr duplex classifier. Overflow from this classifier is divided among one 6-ft.x25-ft. and two 6-ft.x23-ft. 4-in. Dorr duplex classifiers, operating in closed circuit with two secondary ball mills. Overflow from the classifiers enters the primary 60-ft. Forrester flotation machines. Froth from these machines is treated in a cleaner machine which produces the finished concentrate. Tailing from the primary machine passes to secondary machines, the froth from which joins the tailing from the cleaner and is then returned to the head of the primary machines. Tailing from the secondary machines is sent to waste.

Electrically operated sampling equipment is employed at various points in the flow sheet. At the primary ball mill, 5- and 4-in. forged chrome-steel balls are charged at the rate of 1.95 lb. per ton of ore; power consumption is 2.84 kw.-hr. per ton. Forged chrome-steel balls, 2 and 1½ in. in diameter, are charged into the secondary ball mills at the rate of 2.3 lb. per ton of ore. Power consumption is 4.94 kw.-hr. per ton. Classifier capacity is being increased by the installation of an 8x30-ft. Dorr bowl classifier, with a bowl 15 ft. in diameter. Power consumption of classifiers and elevators in the plant averages 0.76 kw.-hr. per ton of ore treated.

Forrester-type flotation machines are used, the 60-ft. primary machines being of steel construction. Air consumption ranges from 60 to 70 cu.ft. per minute per foot of machine length. An alkaline flotation circuit is maintained. Aërofloat, Aërocyanide, and pine oil comprise the reagents used. A total of 750 tons of ore is treated daily, 615 tons of which is ground through 200 mesh. Power consumption per ton of minus-200-mesh product is 11.9 kw.-hr. A



Ore train at smelter bins

table of typical screen analyses and a record of metallurgical results for the period of Oct. 1, 1928, to Nov. 30, 1929 follow:

Mesh	Mill Feed, Per Cent	Primary Mill Discharge, Per Cent	Primary Classifier Overflow, Per Cent	Secondary Classifier Overflow, Per Cent	Flotation Feed, Per Cent
Plus 48.....	91.10	57.95	42.20	.....	....
Plus 65.....	92.65	65.10	51.40	0.40	....
Plus 100.....	93.60	69.40	57.10	4.20	3.4
Minus 200.....	5.15	23.70	34.00	78.20	83.1

Metallurgical Results

	Copper, Per Cent	Iron, Per Cent
Heads.....	4.68	10.13
Concentrate.....	21.40	25.83
Tailing.....	0.415	6.14
Ratio of concentration.....	4.87	4.93
Recovery.....	92.99	51.7

Flotation concentrates, sintered concentrates from the Dwight & Lloyd plant, and flue dust are stored in the smelter bins. The flotation concentrate, as shown in the accompanying flow sheet of sintering, blast furnace, and refining operations, is delivered by belt conveyors to the sintering plant, where it is mixed with flue dust and crushed limestone, and sintered for blast-furnace feed. The plant comprises two Dwight & Lloyd machines, having a combined capacity of 130 tons of sinter per day. No. 1 machine is 42x264 in., and No. 2 machine, 42x396 in., the speed of grate travel being 22 and 33 in. per minute, respectively.

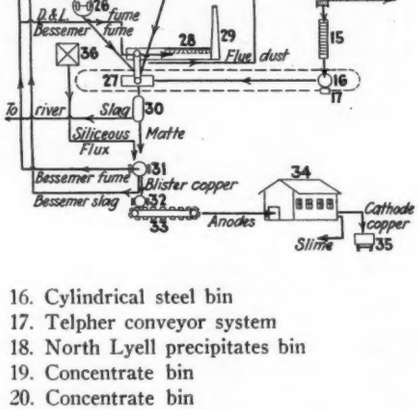
Ignition is by coal, in water-cooled fireboxes, under forced draft. The sinter is discharged onto a Marcus shaking-screen conveyor, the fines being returned for re-treatment. The coarse material is discharged into an inclined pan conveyor, and then passes to a cylindrical, steel distributing bin on the blast-furnace feed floor, whence it is transferred in inclosed hopper-bottomed buckets to the blast-furnace charge plate by means of a Telpher conveyor system.

Smelting was begun in 1896, and went through various stages of development of pyritic and semi-pyritic smelting to the present simple smelting of raw and sintered concentrate, high-grade siliceous ore, and returned converter slag. One furnace, 42x126 in. at the tuyère level and 13 ft. 10 in. high from tuyères to feed floor, is in blast about 50 per cent of the year. A pressure of 20 to 30 oz. per square inch is employed. During the last six months the percentage of raw concentrate in the charge has been greatly increased, without detriment to metallurgical results. The usual charge prior to this period was: Sinter, 2,100 lb.; raw concentrate, 600 to 800 lb.; converter slag, 800 lb.; coke, 350 to 400 lb. Current charge is: Sinter 1,050 lb.; raw concentrate, 1,850 lb.; converter slag, 800 lb.; North Lyell ore, 300 lb.; coke, 325 to 350 lb. The increase of raw concentrate in the charge has reduced the

Key to Equipment Shown in the Illustration Below

1 and 1a. Flue dust bins
2. Crushed limestone bin
3. Flotation concentrate bin
4. Belt conveyor
5. Mixing table; diameter, 10 ft.
6. Concentrate bin; capacity, 200 tons
7. Bucket elevator; vertical lift, 42 ft.
8. D.&L. feed bin No. 1; capacity, 30 tons
9. D.&L. feed bin No. 2; capacity, 32 tons
10. Shaking feeders, 9 ft. long, slope 30 deg., 240 strokes per minute
11. Fire boxes; coal fuel
12. No. 1 D.&L. machine; dimensions, 42 in. x 264 in.; speed, 33 in. per minute
13. No. 2 D.&L. machine; dimensions, 42 in. x 396 in.; speed, 22 in. per minute
14. Marcus screen
15. Pan conveyor

Flow sheet of Mount Lyell sintering, blast furnace, and refinery operations



16. Cylindrical steel bin
17. Telpher conveyor system
18. North Lyell precipitates bin
19. Concentrate bin
20. Concentrate bin
21. Bessemer slag bin
22. Concentrate bin
23. Coke bin
24. Limestone bin
25. Sinter bin
26. Pug mill
27. Blast furnace; size, 42x120 in.; blast, 24 oz.
28. Blast furnace flue
29. Blast furnace stack
30. Forehearth
31. Basic lined bessemer converter; diameter, 10 ft.; air consumption, 7,000 cu.ft. per minute; pressure, 13 lb.
32. Copper ladle; capacity, 7 tons.
33. Anode casting machine, straight-line type
34. Electrolytic refinery
35. Standard railway trucks; capacity, 18 tons
36. High-grade North Lyell ore bin; capacity, 425 tons
37. D.&L. fans; speed, 900 r.p.m.

grade of the matte from an average of 55 to 50 per cent, but it has permitted a fair tonnage of siliceous ore to be treated direct in the furnace. New cupriferous material treated daily in the furnace averages 300 tons. The coke, which has an ash content of 18 per cent, comprises 9 per cent of the charge, and amounts to 0.6 tons per ton of blister copper produced. Typical analyses of sinter, raw concentrate, and high-grade North Mount Lyell ore are shown in the following table:

Analyses of Mount Lyell Ore

Figures represent per cent of content

	Sinter	Raw Concentrates	High-Grade North Mount Lyell Ore
Copper	20.5	18.3	17.0
Iron	27.6	28.2	9.8
Sulphur	12.6	33.8	....
Alumina	....	4.3	4.1
Silica	17.8	10.2	47.2
Barium sulphate	....	....	6.3

A typical analysis of the slag is: Copper, 0.45 per cent; silica, 33.4 per cent; ferrous oxide, 53.1 per cent; barium oxide, 0.70 per cent; alumina, 5.89 per cent; and lime, 3.13 per cent.

Converting, which commenced simultaneously with smelting, was, until 1918, done in acid-lined vessels. Since then converters with basic lining of magnesite bricks have been in use. Two converters of the Great Falls upright type, each 10 ft. in diameter, are employed. Blast pressure ranges from 12 to 15 lb. per square inch, the volume being 7,000 cu.ft. of free air per minute. The amount of blister copper produced daily in one converter, exclusive of returned scrap from the refinery, is 50 tons.

The new refinery of the company contains 16 stripper and 84 commercial cells, or a total of 100 cells. Average current density in the commercial cells ranges from 32 to 33 amp. per square foot. A current of 10,750 amp. at 60 volts is employed. Ampere efficiency averages 90 per cent, and the amount of cathode copper deposited per kilowatt-hour is 3.7 lb. Each commercial cell contains 21 anodes, weighing 600 lb. each and measuring 27x36 in. x 2½ to 3 in. in thickness, and 22 cathodes, weighing 90 lb. each and measuring 30 x 38 in.

Anodes are drawn at eighteen-day intervals, and cathodes at three-day intervals. The amount of anode scrap produced averages 10 per cent. Each stripper cell contains 22 anodes, weighing 700 lb. each and measuring 30x37 in. x 2½ to 3 in. in thickness. Starting sheets produced weigh 7¾ lb. and measure 31x38 in. Anodes are drawn at 30-day intervals, and starting sheets every 24 hours. The total weekly output is 168 tons of cathode copper, 2.3 tons of anode slime, and 3 tons of first-grade bluestone.

Underground Iron Mining in Russia

A. K. Bouldovsky
Translated by W. Ayvazoglou

INTERESTING features of Russian practice are described in this article, certain variations from American practice being of possible limited application elsewhere.

The practice described is that which obtains in the District of Krivoy Rog, which produces about 70 per cent of the total iron ore output of Russia. This district is in the Ukraine, about 200 miles northeast of the Black Sea port of Odessa. The ore occurs in stratified deposits of a thickness averaging about 70 ft., but with a maximum of 350 ft. Angle of dip varies greatly. The ore is largely a red hematite, with a specific gravity of about 5. Two classes are mined: high-phosphorus, with a content of 55 to 60 per cent iron, 6 to 7 per cent silica, and 0.05 to 0.3 per cent phosphorus; and low-phosphorus ore, containing 60 to 67 per cent iron, about 9 per cent silica, and 0.05 per cent phosphorus.

Present underground mining methods were preceded by open pits, and in many instances the inclined shafts are sunk from the pit bottoms. At some mines, however, vertical shafts have been sunk from the surface. Shafts are used either for hoisting the ore or for bringing down filling material. The deepest development so far is 980 ft., but the mean depth of most of the mines is 420 to 490 ft. below the surface.

The greatest expense in mining the ore is for the preparatory work of constructing drifts, winzes, and crosscuts, so the author has developed coefficients of economy for the various methods of mining used, which coefficients are based on the relation of the volume of the developed ore to the amount of development work. In mining the beds of a thickness of from 14 to 21 ft., three principal systems are used: (1) a continuous system along the strike of the ore—overhand stoping; (2) the bord-and-pillar method along the strike of the ore; and (3) the crosscut system—mining the ore by slices perpendicular to the strike of the ore deposit. The thicker deposits are mined by several systems, of which the following are described: (1) Overhand stoping with removal of the ore by successive inclined slices; (2) the large chamber system; (3) the crosscut or level system, removing the ore by slices either along the strike of the orebody or perpendicular to it; (4) the chamber-trench system, dividing the ore deposit into short sections and mining alternate sections simultaneously by using cross drifts one above the other and working downward; (5) a shrinkage method, using chamber magazines, by which the roof is undermined and the ore is accumulated; and (6) a system of cover caving, removing the ore by successive slices, known in Sweden as the rasbrytning system.

When the beds are more than 14 ft. thick, all preliminary development which is to be used for a considerable period must be done in the wall rocks, preferably in the footwall. The system best adapted to the mining of ore deposits of small thickness is the crosscut method of excavation along the strike of the orebody. It has a high coefficient of economy and is very productive, but it lacks uniformity in the mining of temporary barrier pillars. The most successful of the systems for mining thicker deposits are: the crosscut system, removing the ore by successive slices perpendicular to the strike of the orebody; the chamber-crosscut system, removing the ore by slices; and the cover-caving system. Both the chamber and the chamber-trench systems require special conditions, such as a considerable tenacity of the ore, necessity of semi-wet filling, and a certain angle of dip. The cover-caving system is the most advantageous, but it has the disadvantage of contaminating the ore.

Brief abstract of U. S. Bureau of Mines Information Circular No. 6254, a translation of an article that appeared in *The Mining Journal*, Moscow in 1922.

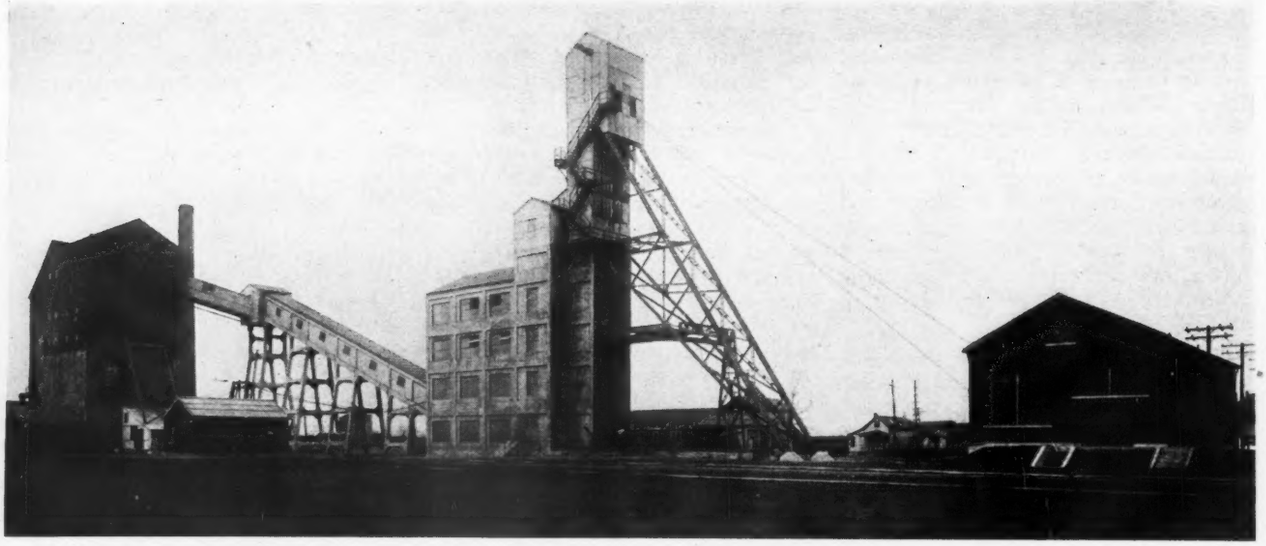


Fig. 1—Surface plant of the Detroit Rock Salt Company

Mining Rock Salt in Michigan

H. D. Keiser
Assistant Editor

Fig. 2—General surface plan

A WESTERN miner, who somehow found himself "mining" in New York City on a subway construction job, is credited with having written a comrade out West, urging that he too come East and join him on subway work, "as it was just like mining in a parlor." Whether or no this story be true, I doubt that any miner could conceive of more satisfactory or "parlor-like" conditions than those found at the mine of the Detroit Rock Salt Company, situated seven miles from the center of Detroit, within the city's limits. The mine is dry, is excellently ventilated, and, except at the working faces, is electrically lighted throughout. No dust, steam, moisture, nor obnoxious gases are noticeable in the clear atmosphere. Mining operations, all of which are electric, produce comparatively little noise.

The salt bed, which is 30 ft. thick and readily drilled, lies in a horizontal position at a depth of 1,100 ft. Timber

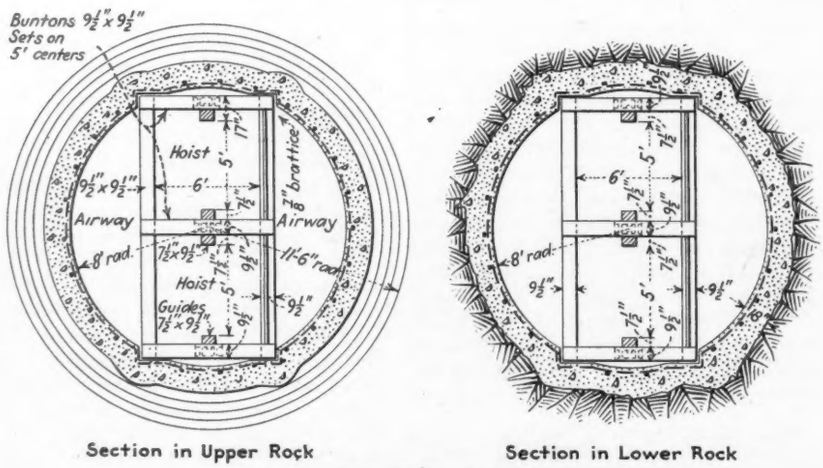


Fig. 3—Cross-sections of No. 2 shaft

support of the roof is unnecessary; the only wood underground is in the form of ties supporting the haulage tracks. Electric drilling and blasting are employed, all firing being done at the end of the shift from the shaft bottom. Electric loading shovels and electric trolley haulage are used. Moreover, the mine workings, as well as the surface plant and surrounding grounds, are kept "spic and span." Certainly, the combination of all these desirable features at one property is unusual.

The aforesaid description might well warrant the supposition that the management of the Detroit Rock Salt Company has been especially favored in its operations by nature and other factors. This assumption, however, is not substantiated by the history of the property, which shows clearly that the present satisfactory conditions at the mine are attributable directly to the solving of several extremely difficult engineering problems and to the successful adoption of the most modern methods of operation to meet an exacting set of economic circumstances.

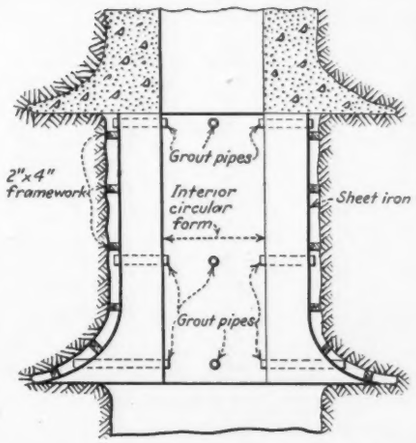


Fig. 4—Construction details of No. 2 shaft

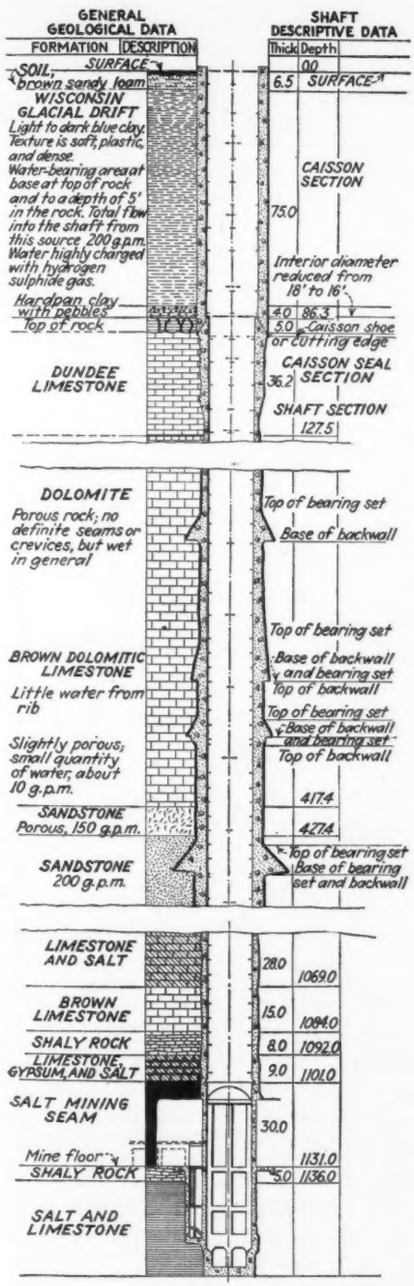
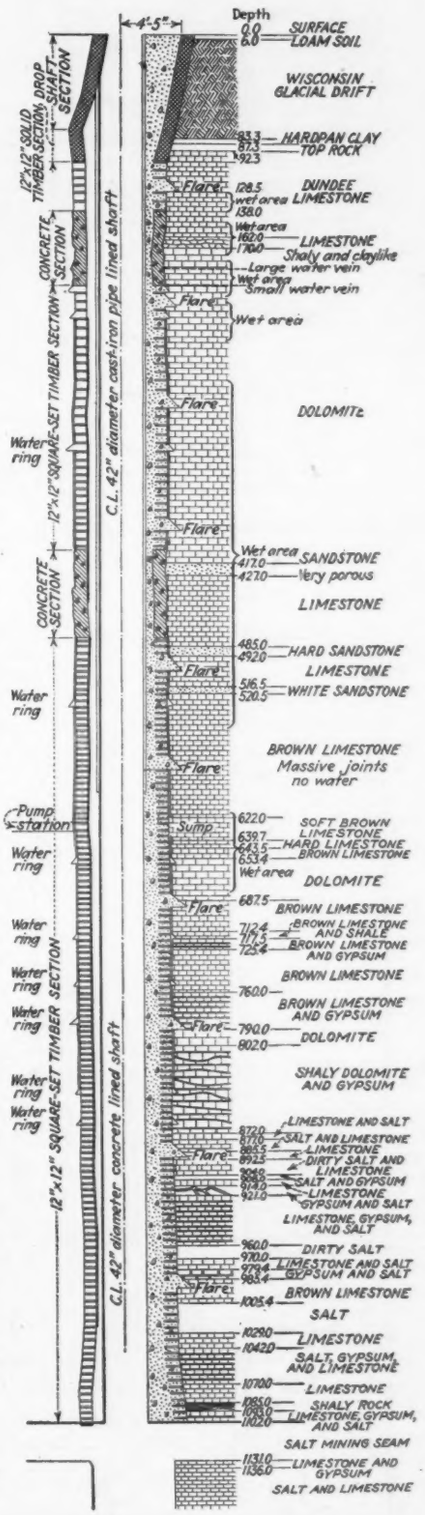


Fig. 5—Columnar sections of No. 2 shaft

The salt bed mined by the company occurs in or about the middle of what is known as the Salina formation, which, at the property, lies at a depth of 870 ft. Alternate layers of compact brown to drab dolomite, rock salt, anhydrite, or gypsum, and then layers of bluish-black shale, comprise the formation. The entire Detroit district, which includes a

Fig. 6—Columnar section of No. 1 shaft



Of the economic circumstances, with which the management must contend, two of the more important may be cited here: (1) Inasmuch as the property is situated within the city limits of Detroit, operations must comply with municipal regulations, which are much more stringent than those applying to most mining companies. (2) The outlet for the company's products is restricted to a comparatively limited market, and its prices must compete with those of other companies that are favored by lower wage scales and less complex operating conditions.

Operations on the tract began in 1906, when local interests started to sink a 1,100-ft. shaft to the salt bed. Following several reorganizations of the company, the shaft was completed in 1910. The method of shaft sinking that was employed and the numerous hazards that were encountered have been described in detail.[1] Subsequent operations of the company proved to be unsuccessful. A trying water condition confronted the management, more than 500 gal. per minute being pumped from the workings. Little or no labor-saving equipment was used. These circumstances, plus financial difficulties, resulted in the acquisition of the property in 1912 by the then newly organized Detroit Rock Salt Company, a subsidiary of the International Salt Company. Operations on the property have been continuous since 1912, and a consistent effort has been made to apply, wherever possible, the most modern labor-saving equipment.

[1]Fay, Albert, H.: "Shaft of Detroit Salt Company," *Engineering and Mining Journal*, Vol. 91, 1911, pp. 565-69.

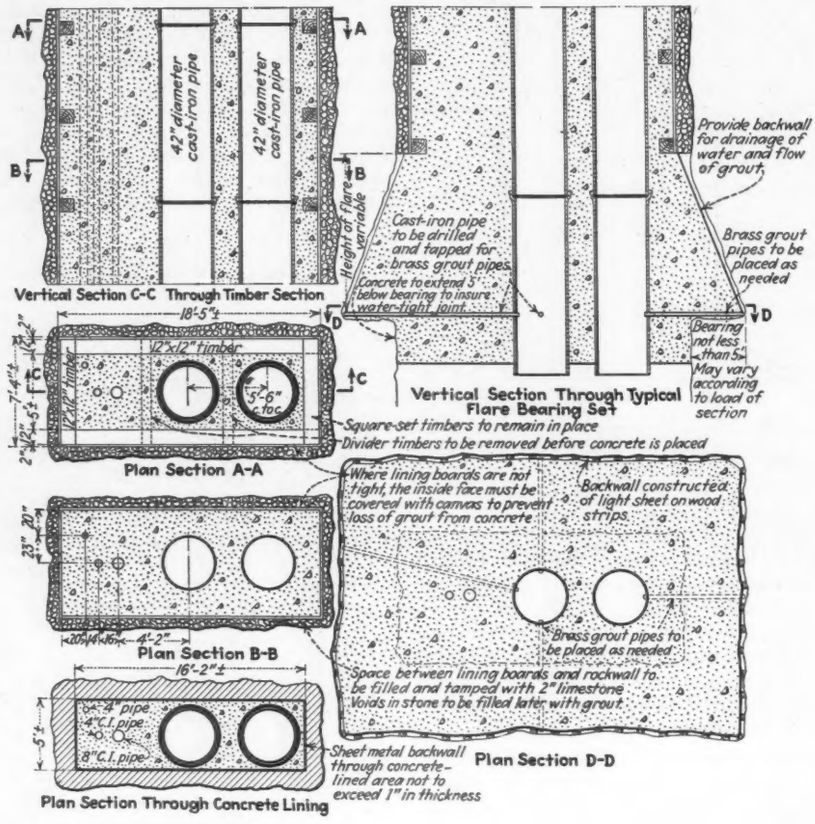

42" diameter cast-iron pipe
42" diameter cast-iron pipe
Vertical Section C-C Through Timber Section
Height of flare variable
Cast-iron pipe to be drilled and tapped for brass grout pipes
Concrete to extend 3' below bearing to insure water-tight joint
Provide backwall for drainage of water and flow of grout
Brass grout pipes to be placed as needed
Bearing not less than 5' May vary according to load of section
Vertical Section Through Typical Flare Bearing Set
12"x12" timber
Square-set timbers to remain in place
Divider timbers to be removed before concrete is placed
Plan Section A-A
Where lining boards are not tight, the inside face must be covered with canvas to prevent loss of grout from concrete
Backwall constructed of light sheet on wood strips
Brass grout pipes to be placed as needed
Space between lining boards and rockwall to be filled and tamped with 2" limestone
Voids in stone to be filled later with grout
Plan Section B-B
4" pipe
4"C.I. pipe
8"C.I. pipe
Sheet metal backwall through concrete-lined area not to exceed 1" in thickness
Plan Section D-D
Plan Section Through Concrete Lining

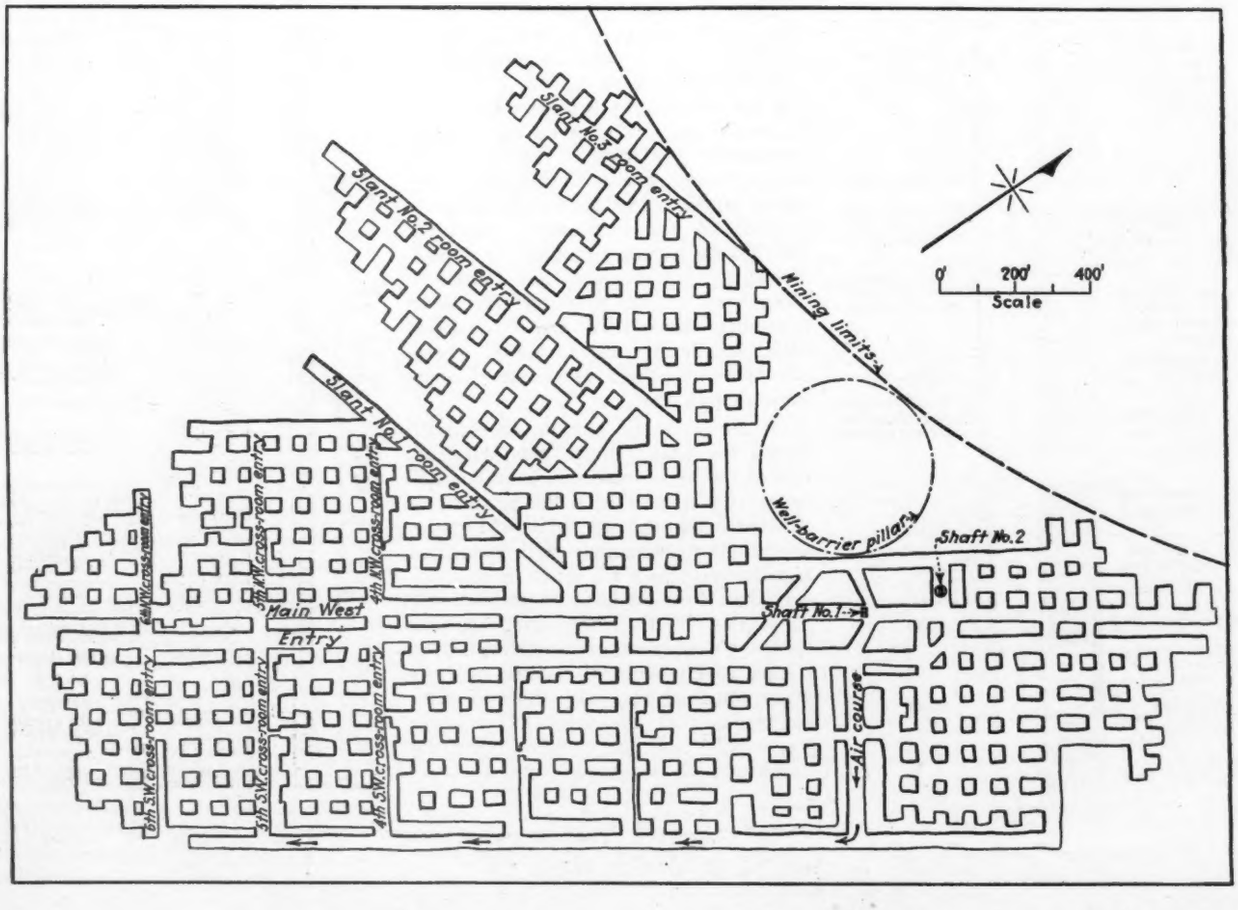
Fig. 7—Cross-sections of No. 1 shaft

land area of 772 square miles, is underlain by the formation, and the thick beds of salt in it are estimated to be capable of yielding unlimited quantities of salt.[2] Notwithstanding this extensive area of the salt bed, the company's property is the only underground rock salt mine in the State of Michigan. This distinction is accounted for by the extreme difficulty experienced in sinking shafts to the bed. A number of evaporating plants, however, obtain salt from one or more of the several beds of varying thickness that are found above the 30-ft. bed. The first of these is encountered at a depth of 900 ft. The salt is dissolved out of the beds with water, and the beds need not, therefore, be particularly pure. In underground operations, however, the salt mined must possess a high degree of purity.

From an engineering standpoint, the major problems at the company's property have been associated with shaft sinking. At the top of the strata that must be penetrated to reach the salt bed is 100 ft. of glacial drift, which is largely of quicksand consistency and highly impregnated with hydrogen sulphide gas. Below this is about 600 ft. of sandstone and limestone, containing numerous watercourses. As the sandstone strata are porous and continuous to the Great Lakes, the water present is

[2]Detroit Folio: "Geologic Atlas of the United States," U. S. Geological Survey.

Fig. 8—Plan of underground workings



under hydrostatic pressure, which exceeds 235 lb. per square inch at a depth of 550 ft.

Two shafts, as shown in Figs. 1 and 2, are now in use at the property. No. 2 shaft, which is circular and of concrete construction, was sunk in 1924 by the Dravo Contracting Company. No. 1 shaft was reconstructed by R. G. Johnson Company in 1926. Attempts were made at No. 1 shaft, prior to its reconstruction, to control the flow of water with a concrete lining, but, owing to the rectangular cross-section of the shaft, the linings cracked. Grouting was also tried, but without success.

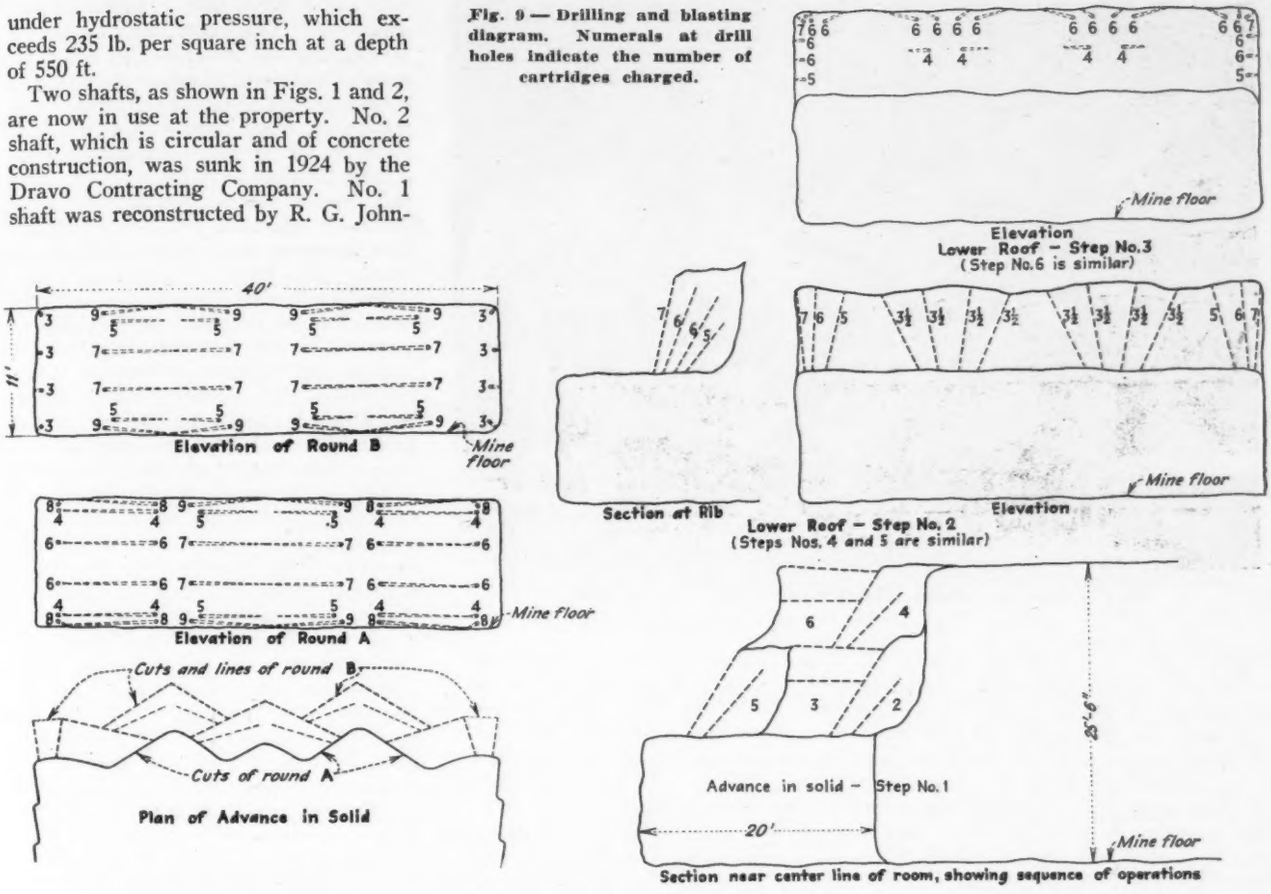


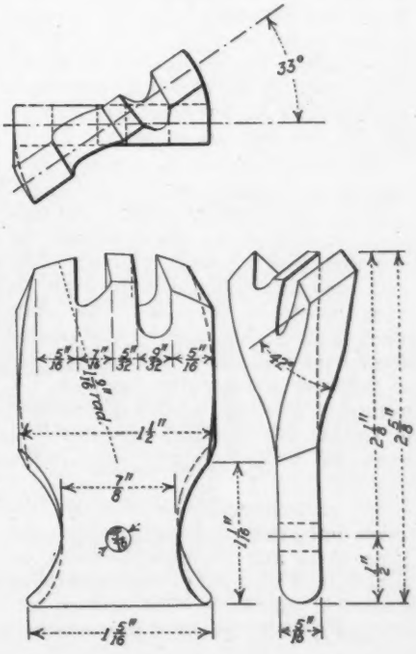
Fig. 9 — Drilling and blasting diagram. Numerals at drill holes indicate the number of cartridges charged.

Construction of No. 2 shaft was undertaken primarily to provide two openings to the mine workings and to obtain accurate information concerning underground water conditions. An interior diameter of 16 ft. and a lining thickness varying from 18 in. to 3 ft. 6 in. were adopted in designing the shaft, as shown in Fig. 3. The minimum lining thickness was increased in steps of 6 in. as the shaft progressed through the upper or water-bearing rock. On reaching the lower or dry rock at a depth of 672 ft., the thickness of the lining was reduced again to 18 in.; this thickness was used throughout the dry-rock section.

The first 94 ft. of the shaft was built on top of a cutting shoe, the material within the shoe being removed with a clamshell excavator as the shoe progressed through the soft strata. From this point, until the dry-rock section of the shaft was reached, sinking conditions were particularly difficult. The general method of construction employed in this section of the shaft consisted of first cutting a bearing notch in the shaft wall to support the weight of the concrete shaft lining extending from the last notch above. A framework of 2x4-in. timber was then erected to conform with the surface of the shaft wall, and sheet iron was fastened to this framework. Grout pipes, which extended from the space between the shaft wall and the sheet iron to within the interior circular form of the shaft lining, carried the inflow of water through the lining section.

Fig. 10—Special cutter used with auger-type drill

The concrete for the lining was then poured, and, after it had set, grout under pressure was forced into the lower grout pipes until it flowed out of the pipes at the top, indicating that the inflowing water had been sealed off. All the pipes were then plugged. Construction of the next lower segment of the shaft lining was then begun. A sketch, showing the principal details of the



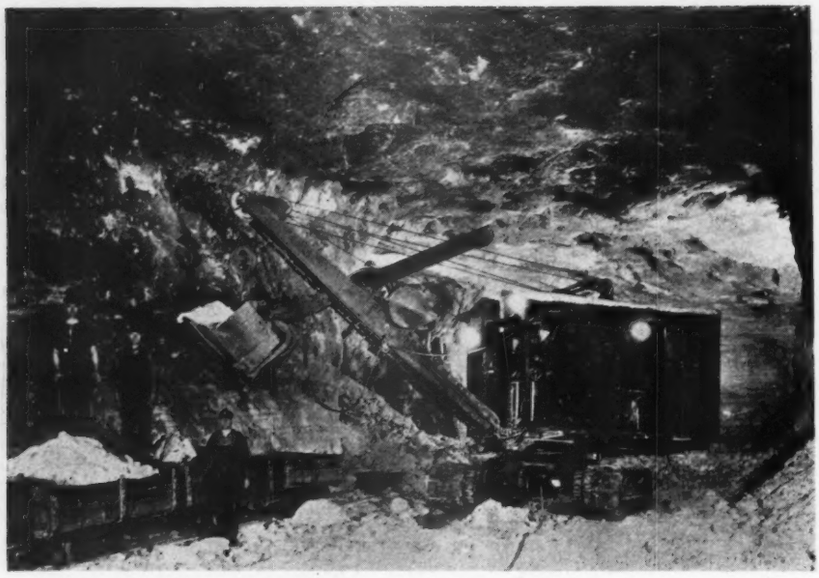


Fig. 11—Electric mining shovels load the salt underground

method, is presented in Fig. 4 on p. 17.

The dry-rock section of the shaft was driven by raising from the top of the salt bed, raising and sinking operations meeting at a point 679 ft. below the surface. At a depth of 630 ft. a connecting tunnel was driven to a pump station at that elevation in No. 1 shaft. By means of this tunnel and station, which were below the water-bearing strata, adequate pumping and ventilation arrangements were made to cope with the water and hydrogen sulphide gas encountered in No. 2 shaft. Columnar sections of the top, bottom, and one of the principal water-bearing portions of the shaft are shown in Fig. 5.

No. 1 shaft, as reconstructed, is undoubtedly unique in the mining industry. As shown in Figs. 6 and 7, it consists, in effect, of a concrete monolith about 150 sq.ft. in cross-section and 1,100-ft. high that is pierced by two vertical circular tubes, each of which is 42 in. in diameter. These tubes are lined with 12-ft. sections of cast-iron pipe to a depth of 599 ft., but from this point to the salt bed they are unlined.

The shaft is now used solely as a man-shaft. Double-deck circular cages, carrying three men to a deck, and Otis elevator shaft guides, are employed. In reconstructing the shaft, the two 42-in. cast-iron pipe columns were built up from the 599-ft. elevation. The joints were caulked, and concrete was poured around the pipes and back to the rock as the work advanced up the shaft. A method of grouting, similar to that used in sinking No. 2 shaft, was employed to seal off various flows of water in the strata.

The underground workings are divided into two sections—namely, the Main West and the Slant sections, as shown in Fig. 8. A room-and-pillar method of mining is used, and an extraction of about 75 per cent is effected. Main haulage entries are driven 40 ft. wide and 300 ft. apart. Rooms are 40 ft. wide by 300 ft. long, pillars being 40 ft. square and spaced at 40 ft. No subsidence has occurred at the property.

Undercutting is not employed in mining the salt bed. The first 11 ft. above the floor is broken off the solid for a width of 40 ft. by alternate rounds of 36 and 32 holes. These rounds, each of which advances the face 3 to 3½ ft., are continued until a total horizontal advance of 20 ft. is made. The upper portion of the bed is then broken over the 40-ft. width by two series of rounds, each 7 to 7½ ft. deep vertically. Drilling and blasting details are shown in Fig. 9. In blasting, 60 per cent ammonia dynamite and electric caps are used. All firing is at the end of the shift from the bottom of the shaft.

Scranton Electric 220-volt drills are employed. The drilling tool is a coal-type auger, fitted with a special detachable cutter. This cutter, which is shown in Fig. 10, was developed by the company from one of a similar type that is used in the salt mines of Germany. The cutters are made from Star-Zenith steel stock in the company's machine shop. Actual drilling time for a 1½-in. hole, 9 ft. deep, averages about 1½ min. Five drills are operated, two men—a driller and a powderman—being assigned to each.

Bulldozing, or the breaking of large lumps of salt loosened in blasting, is effected by two different methods at present. In the Slant section, the lumps are drilled with electric Chicago Pneumatic auger drills, which are of the small hand-held type and drill a ⅞-in. hole. After being charged, the holes drilled in the lumps are fired at the end of the shift from the shaft bottom, in the same manner as the mining rounds. In the Main West section, however, tests are being made with Ingersoll-Rand and Sullivan pneumatic picks, with which the lumps are readily broken down into pieces of suitable size. "Bull points" for the picks are made on the property. Operating power is obtained from a portable, electrically driven, I-R compressor of the railroad type that is readily lifted off the rails and blocked up whenever it is used in a new working place. A decision has not as yet been reached as to which method of bulldozing will ultimately be adopted throughout the mine.

The broken salt is loaded into 3-ton cars for transport to the hoisting shaft by a Marion Type-20 electric mining shovel, equipped with a ¾-yd. dipper. Two of these shovels, one of which is shown in Fig. 11, are in operation in the mine—one in each section of the workings. From 1,000 to 1,500 tons of salt is blasted in a room before drilling is suspended and a shovel brought into the room. Each shovel loads about 600 tons or 200 cars per nine-hour shift.

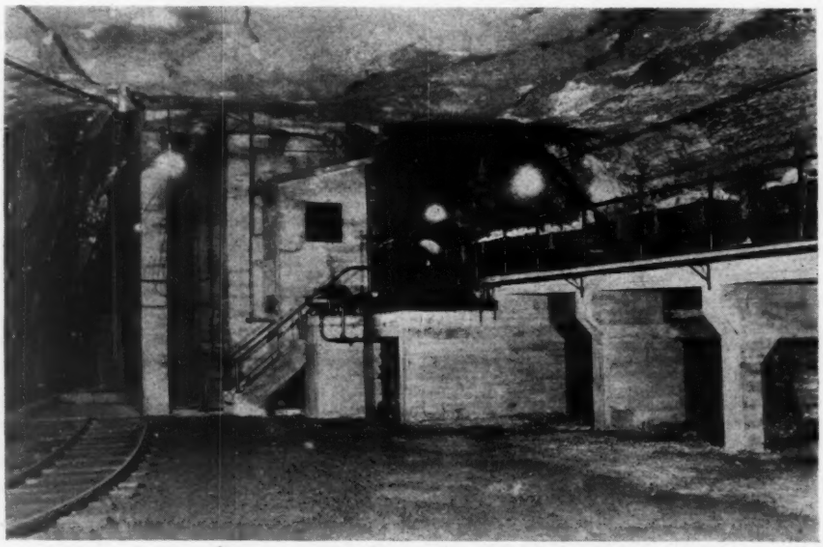


Fig. 12—Car haul, car dump, and No. 2 shaft substructure

A shovel crew comprises three men: One shovel operator and two men that bulldoze the large lumps and extend the track as required for loading operations. The hoist and crowd movements of the shovel are performed by compressed air, which is obtained from a compressor situated on the shovel. This compressor is driven by an individual 440-volt alternating-current motor. A motor-generator set on the shovel converts the 440-volt alternating current delivered to the shovel to 320-volt direct current, which is used for all the other shovel operations. Transformers, situated at the bottom of No. 2 shaft, reduce the 4,600-volt current brought into the mine to 440 volts for delivery to the shovel and other equipment.

Loaded cars are moved by 4-ton General Electric cable-reel locomotives from the shovels to the main haulage lines, where trains of twelve to eighteen cars are made up and transported by 6-ton G.E. trolley locomotives to an electrically operated car haul at No. 2 shaft. A track gage of 38 in. is used throughout the mine; 40-lb. rail is employed on the main haulage lines, and 30-lb. rail in the rooms. A motor-generator set at the bottom of No. 2 shaft converts the 440-volt current to 220 volts for the trolley lines and the aforesaid Scranton Electric drills.

At the car haul, shown in Fig. 12, the locomotive is uncoupled, and the cars are moved, one at a time, onto an off-center car dump, equipped with a counterbalance and a spring-return device. Inasmuch as the cars have swivel couplings, dumping does not necessitate uncoupling. Only one man is required to operate both the car haul and the car dump. The salt passes from the car dump into two skip chutes, each of which has a capacity of 6 tons. In leaving the bottom of the shaft, the loaded skip automatically raises the lip of the chute, which, in this position, affords the storage capacity of 6 tons. When the empty skip descends, it automatically lowers the lip of the chute, and the salt therein is discharged into the skip. The capacity of the skips is 6 tons each. Ore-handling facilities at the bottom of No. 2 shaft were designed by the Allen & Garcia Company.

Both No. 1 and No. 2 shafts are used as upcast shafts. A curtain wall in No. 2, however, provides a downcast air compartment outside of the hoisting compartments. An American Blower Sirocco No. 10 single-inlet fan supplies 50,000 cu.ft. of air per minute in the summer, and about 25,000 cu.ft. in the winter. The air is heated during the winter by passing it over steam coils at the intake side of the fan.

Total inflow of water into the mine is only 1½ g.p.m. This water is stored in two large barrels near No. 2 shaft and is pumped to the surface by two Gould triplex pumps, pumping operations being limited to two or three hours per day. Mine operations are on a single nine-hour shift basis. At present 42 men are employed underground. The normal rate of output is 900 tons a day. During capacity operations, however, the daily output is 1,500 tons.

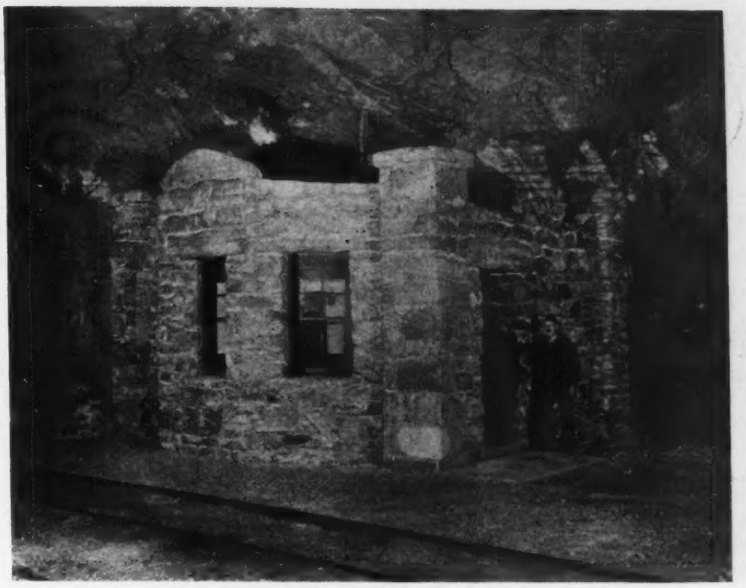


Fig. 13—Underground foremen's office, which is made entirely of rock salt

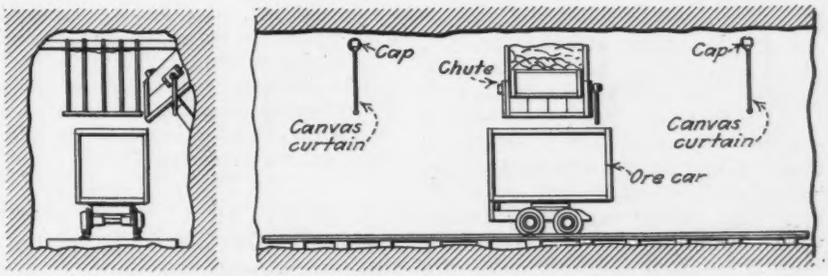
In closing this discussion of the company's mining operations, additional reference should be made to the cleanliness evident everywhere underground. No refuse of any kind is noticeable, and at the same time no surplus equipment is seen scattered about the workings. The roadbed of the haulage lines has a trimness which resembles that of a well-maintained railroad, and particularly noteworthy, in this instance, is the dryness of the workings. The mine is a silent, though expressive, tribute to efficient management.

A description of the processing methods employed by the Detroit Rock Salt Company will appear in a second article entitled "Processing Rock Salt for the Market," which will be published in an early issue.

Canvas Curtains Prevent Haulage Accidents

UNDERGROUND loading chutes that protrude into drifts and tunnels are a hazard to underground workers. Many serious accidents occur every year as a result of men carelessly riding on ore or waste trains and being struck by such chutes. A means of preventing accidents of this nature, by warning the train rider in time of the approaching danger, is shown in the accompanying illustration. This simple and efficient arrangement was developed in the Butte district, where it has helped considerably to decrease underground accidents.

The men on trains are warned by a small canvas curtain suspended from the cap of a timber set situated a short distance away, in each direction, from the location of the chute.



Canvas-curtain warning for train riders prevents haulage accidents

SIXTY YEARS AGO

1870-1930

☞HOW TO VISIT MONTANA — In no field perhaps is there more contrast between the times of our grandfathers and great grandfathers and our own than in that of transportation. It is no trick at all to visit Montana these days, either by air or by luxurious Pullman on any one of a number of railroads. Not so in 1869. The Aug. 17 issue of the *E.&M.J.* of that year gives directions for reaching the state, and it would seem that the hardy prospectors of those days must have been the principal travelers:

"The stage lines for Idaho and Columbia River, and also for Montana, leave the railroad route near the head of Salt Lake. The distance to the capital of Idaho is 250 miles, and to Columbia River 500. On the Montana line it is 300 miles to Virginia City, 425 to Helena, and 560 through to Fort Benton, the head of navigation of the Missouri River. The rates of stage travel are about twenty cents a mile, and the meals at the stations along the roads generally $1.50. This is the quickest route for reaching Montana. The only alternative left is to go up the Missouri River on steamboats to Fort Benton, which is within 100 miles of the heart of the territory. But the river journey is long, nearly 2,000 miles, and tedious, requiring from two to three weeks. The mere visitor to Montana, at least, should go by the stages from Salt Lake, across to Fort Benton, and then pass down the river, either by steamboat or on an open floating boat, to Omaha. Such a trip would take in all three weeks to a month, but would be a very interesting and recompensing circuit. The stage service on the Montana route is perhaps the best on the continent; the roads are hard and excellent; the scenery, through an open mountain country, fresh, picturesque, and every way inviting."

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☞WHEN NUGGETS WERE NUGGETS—The biggest gold nugget until then unearthed was found in Dunolly, Australia, in 1869, and weighed 210 lb., troy, yielding 2,268 oz. of gold on melting. The two men who found it were "dead broke"; "the storekeepers had refused them any further credit, and they were feeling very badly indeed, when one of them, in following the claim by working round the roots of a tree, struck something hard with his pick immediately below the surface. He had no idea, however, what had stopped his pick, for, miner-like, he grumbled out: 'Confound it! I wish it was a nugget and had broken the pick.' [Editor's Note — Australian miners were evidently mealy-mouthed in those days.] The nugget, when it was unearthed, was named the 'Welcome Stranger' and is believed to be the largest mass of gold ever discovered." Can any of our readers bring the story of the biggest nugget up to date? Or does the record still stand?

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☞THE GOLD HILL FIRE — The Comstock Lode (discovered in 1859) was the scene of considerable excitement in the spring of 1869, when fire broke out in the Kentuck mine, at Gold Hill, Nev., and, spreading to the Yellow Jacket and Crown Point, was the cause of the death of 36 men. Many weeks passed before it was put out. The deaths were attributable to the same factor all too common today—lack of an emergency shaft and underground connections, with no prearranged ventilation system, in case of fire.

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☞WHY AERIAL NAVIGATION WAS IMPOSSIBLE — In the summer of 1869 a flying machine was built in San Francisco called the "Avitor," and there was some talk of flying it to New York. Such a weird idea was the object of a very skeptical editorial in the *E.&M.J.* Says the Editor: "Every mind is satisfied that the force of the wind is such that even with a moderate breeze such an affair must move in the direction that the wind blows. . . . The size of the balloon necessary to support the weight of the machine and passengers is such that it offers an amount of surface on which the wind exerts a pressure nigh to irresistible for any amount of power that can be carried along with it. . . . A balloon, or flying machine, has not the advantage possessed by a sailing vessel, of a heavy medium, as, for instance, water, underneath it, the resistance of which can be used to change the direction in which the wind would otherwise carry it."

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☞COST OF TRAVEL TO CALIFORNIA — A trip from New York to San Francisco took considerably more time in 1870 than it does today, but the total cost was not greatly different. The through ticket cost $150. The Pullman fare to Chicago was $3, to Omaha, $3, to Promontory $8, and to Sacramento $3. Meals for the seven-day trip amounted to $15, or a total of $185 for the entire trip. "Greenbacks go all the way to Sacramento. The first coin I paid out was for dinner on the steamer 'Yosemite,' after leaving the steamboat landing at Sacramento City. No trouble with baggage, as it is checked all the way, per the baggage master as he passes through the car."

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☞MOTIVE POWER IN MINING DISTRICTS — The problem of power generation in mining districts could not always be disposed of as easily as now, when oil or coal is generally available at no great cost, and a high-tension transmission line is often not far away. In the Oct. 5, 1869, *E.&M.J.*, the various possibilities are outlined in an editorial. Water power, it was pointed out, was usually scanty in desert districts, and wood and coal fuel not easily available. Substitutes of more or less promise included Captain Ericsson's solar engine, an experimental project for utilizing the heat of the sun; several projects for generating and utilizing electricity, but "electricity, as a motor, is too costly to be used with profit"; and the windmill, which the Editor was inclined to consider the most worthy of further development. In the last few decades other more dependable sources of power have become available than those dependent upon the wind, but still, for certain small farm installations, windmills are, to this day, useful, and had as much thought been given to them as to modern engines of other types, they would probably have been developed into considerably more efficient machines. The way the wind blows in the Southwest suggests considerable power going to waste, and the momentum of a good healthy sand storm, such as we have frequently experienced during a sojourn in Arizona, must be immense.

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☞ FORGOTTEN MINING STOCKS—*Engineering and Mining Journal* published quotations on the leading mining stocks, coal-mining securities then being included, but the names of the old-timers are now almost entirely strange to the modern reader. About 70 gold and silver mining companies were listed. 25 copper and lead companies, and six miscellaneous. Of these, the only ones that continue in the stock-quotation list today are Isle Royale Copper, St. Joseph Lead, and New Jersey Zinc, though the location of the St. Joe mine was given as Michigan. E. H. R.

Shaft-Sinking Methods

at Park Konold and Park Premier

John B. Huttl
Assistant Editor

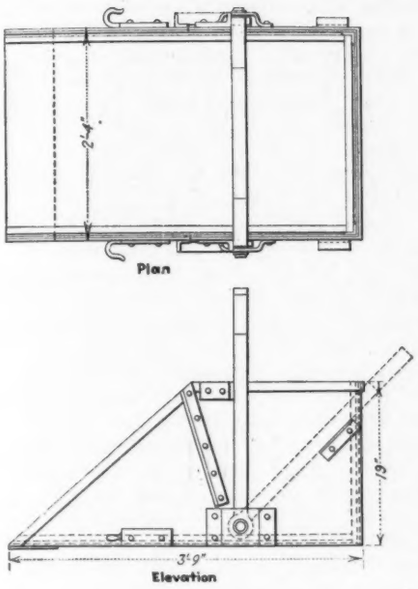


Fig. 1. Loading skip

INCREASED sinking speed at lower costs has been accomplished by the International Smelting Company through the application of new mechanical methods in sinking the 1,200-ft. Park Konold and 500-ft. Park Premier shafts at its East Park City holdings, near Keetley, Utah, about 40 miles southeast of Salt Lake City. Both shafts are being sunk through a loose and broken-up porphyry formation to explore proved limestone sedimentaries below the porphyry.

As the first and most important consideration in shaft sinking is the proper design and arrangement of the surface plant, every attention has been given to this matter at the property. Because of the great distance between the three major workings—namely, the two shafts and the Victory tunnel—three surface plants, well equipped with modern machinery, have been erected to facilitate sinking and drifting operations.

The surface plant at the Konold shaft consists of a combined hoist and compressor house, about 20 ft. above the mouth of the shaft, which contains an 800-cu.ft. capacity motor-driven Chicago-Pneumatic air compressor, a Gardner-Denver Type 2XM-20 auxiliary compressor, and a Webster, Camp & Lane double-drum hoist driven by a 100-hp. induction motor; a small blacksmith shop for minor repairs; a carpenter shop equipped with an electric-driven DeWalt Woodworker for timber framing; a change house; and a reconditioned 40-ft. wooden headframe.

A 20-ft. headframe, made of 10x10-in. timber, a hoist house with its Denver Iron Works single-drum hoist, a small carpenter shop where shaft sets are framed by hand labor, and a change room comprise the surface plant of the Premier shaft.

At the adit level of the Victory tunnel are a second compressor plant, containing an I-R Imperial Type 10 air compressor driven by a 100-hp. Westinghouse motor, which supplies air for underground operations at the Premier shaft and Victory tunnel; a large blacksmith shop, equipped with a Gardner-Denver Model 6 drill sharpener and a G-D oil forge, for reconditioning all drills used at the various workings; and a warehouse and office.

Electric power is purchased from the Utah Power & Light Company, and three outdoor transformer stations are provided to reduce the supplied current to the desired voltage.

The old 360-ft. Konold shaft was retimbered and enlarged to three compartments before sinking operations were resumed. For timbering, 10x10-in. Oregon fir sets, each compartment of which measures 4 ft. 2 in. x 5 ft. in the clear, are used exclusively. Particular attention is given to lagging and the blocking of each shaft set. Because of the loose ground, the timbering is carried close to the bottom. A complete set comprises 2 wall plates; 2 end plates; 2 dividers; 8 posts, 4 ft. 7 in. long; and four ⅞-in. hanging bolts to facilitate assembly and alignment. Each set is carefully blocked and wedged against the rock walls by 3x10x12-in. tenet blocks, 3x10-in. key boards, and wooden wedges. Blocks not exceeding 10 in. long are allowed for this work; and, if the distance between the rock walls and the corners of the sets is greater, a second or third key board is inserted to insure a better anchoring of the sets. In the manway, wooden ladders are placed in a zigzag formation, with a small platform provided at each ladder section.

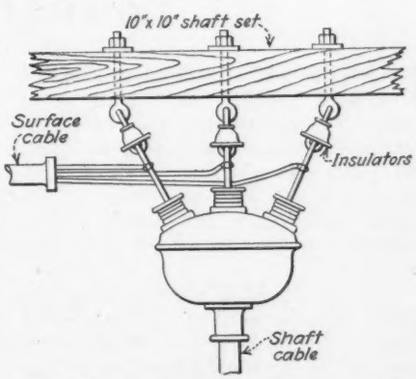


Fig. 2. Method of suspending main shaft cable

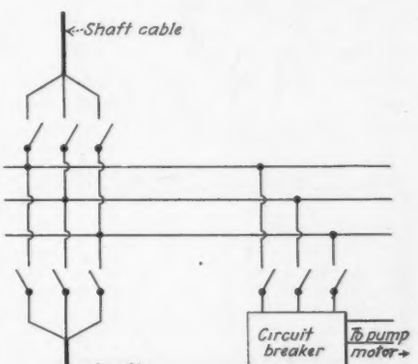


Fig. 3. Station wiring diagram

Drilling operations are performed with I-R S49 Jackhamers and ⅞-in. hexagonal hollow drills. Five feet is about the average round broken with drill holes arranged in the manner as illustrated in Fig. 5. Each hole is started and drilled to a depth of 12 in., with a 2½-in. bit, and a short length of 2-in. pipe is then placed into the hole before drilling is resumed. With this method the sticking of drills, caused by small rock particles falling into the drill holes and thus blocking the drill bit,

can be avoided successfully.

For blasting, Hercules electric blasting caps are used exclusively. The firing is effected through a standard 220-volt switch, situated on the surface, which, with fuses removed when not in use, is kept under lock and key.

The most interesting feature of all operations at the Konold shaft is the mechanical mucking method, as illustrated in Fig. 4. All hoisting operations are performed through the north compartment by a specially designed cage equipped with 12-ft. sinking shoes to permit its lowering below the last set of timber. One side of the cage is fitted with short guide shoes, and built so as to provide an opening sufficiently large to allow a direct dumping of the 14-cu.ft. capacity loading skip, as shown in Fig. 1, into which the broken rock is hand-shoveled without difficulty, the skip being but one-third the height of the usual sinking bucket employed for this operation. It is made

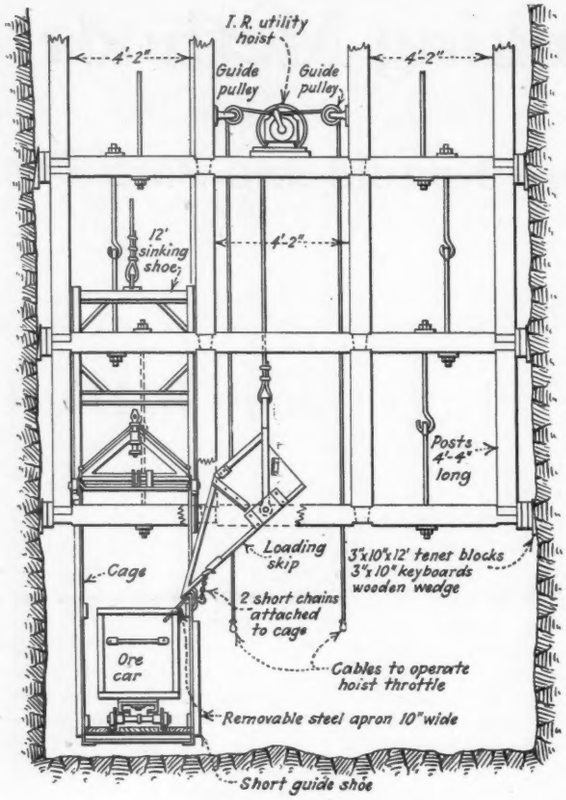


Fig. 4. Mechanical mucking at Park Konold shaft

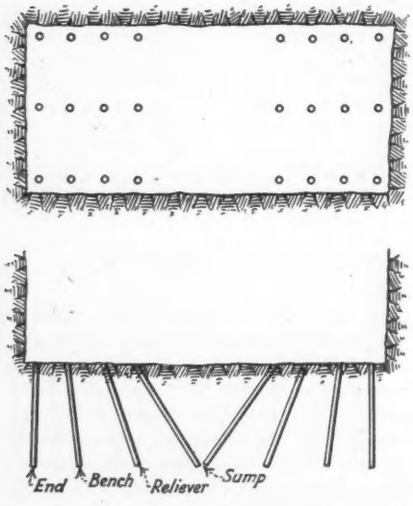


Fig. 5. Arrangement of drill holes, Park Konold and Park Premier shafts

of ¼-in. sheet iron, reinforced with 2-in. angle and strap irons, and is operated by means of a small I-R Utility hoist installed in the middle compartment of the shaft. Two small hooks on the loading skip, onto which the two short chains of the cage are connected, and a removable sheet iron apron, 10 in. wide, are provided to facilitate proper dumping of the skip contents into the ore car. Considering that loading of broken rock into a hoisting conveyance occupies about half of the shaft-sinking time, the savings thus effected, which cut the time usually required for mucking more than 20 per cent, are considerable.

The complete sinking cycle, that is, drilling, blasting, mucking, timbering, and hoisting, is performed by three shifts working seven days a week. Each shift consists of four men working underground, one man on the surface, and one hoist man. The average sinking speed is from 26 to 28 ft. per week. Accumulated water is conveyed from the shaft bottom to the pump sump on the 360 level by a Cameron No. 9-B vertical sinking pump; from this point a Byron-Jackson centrifugal pump of 275 g.p.m. capacity, driven by a 30-hp. motor, raises the water to the surface. The 6-in. pipe column is installed in the manway, with 14-ft. slip joints to permit an easy changing of new 10-ft. pipe lengths when required. Another novel feature is the method of suspending the three 150-amp. underground power cables, illustrated in Fig. 2, which transmit the necessary power for pumps and other machinery installed underground. The underground station wiring system, as shown in Fig. 3, is very practical, safe, and flexible.

Almost the identical methods are applied in sinking the two-compartment Premier prospect shaft, with the exception of the mechanical mucking arrangement, which cannot be used to advantage in a small shaft. At this shaft the usual bucket arrangement is employed for hoisting the men and material and the broken rock to the surface. Three men underground, one surface man, and a hoist man are employed per shift, and about 28 ft. of shaft is sunk per week. Air for ventilation is supplied by a Coppus Ventair blower, and a Cameron No. 9 sinking pump is installed in the manway to convey the shaft water to the surface. The shaft sets are made of 10x10-in. Oregon fir, and each compartment, as previously mentioned, measures 4 ft. 2 in. x 5 ft. in the clear. The same number of hanging bolts and method of blocking is used as in the Konold shaft.

My thanks are due to H. A. Geisendorfer, manager of the mining department, International Smelting Company, and to A. J. Wondershek and E. C. Stephens, superintendent and geologist respectively, in charge of development operations at Park Konold and Park Premier, for the data contained herein.

Use of "Wooden Powder" Inadvisable

IN SOME mines the use of so-called "wooden powder" in blasting is in vogue. At one property the practice is confined to raises. In loading his holes, the miner uses alternate sticks of powder and wood, the latter being of the same dimensions as the powder. The purpose is to secure economy in the use of powder.

This practice is not common, however, and is not considered good by explosives companies, says Arthur LaMotte, manager of the Du Pont company's technical section. The reason is that the detonating wave seldom carries with full effect through the wooden spacers, and consequently bad fumes—in some cases, poisonous fumes—are more likely to be generated than where only dynamite is loaded. A much better effect would be obtained by using cartridges of dynamite of smaller diameter and placing them end to end in the hole when an air-cushioning effect is desired. With the large variety of explosives, having widely different physical characteristics, that is now available, it is usually possible to select one which will give the effect desired, even when the borehole is entirely filled.

Cost of Producing Copper in the Americas

G. W. Tower, 3d

Mineral Research Corporation, New York City

COPPER production cost data are interesting for several reasons: First, as relatively important factors in gaging the profit possibilities of the copper companies at various price levels of the metal; second, for comparing costs of different companies and types of operation; third, in measuring the trend of costs, individually and collectively. The relation of production cost to the selling price of copper has been frequently mentioned.

In considering cost data a few facts must be kept in mind. In a generally abnormal year such as 1929, the bearing of costs on profits is varied and the percentage of output sold by each producer must be determined to calculate actual revenue. Furthermore, the per pound of copper costs for different companies vary somewhat in the degree of accuracy with which they may be regarded. Where the wide scope of activities of some of the larger companies includes a varying array of credits from other metals, metal products, dividends received, and revenue from allied operations, the calculated cost per pound of copper becomes an involved figure, likely to change with fluctuation in the price level of metals credited, dividends received, and other factors. In this class might be mentioned Phelps Dodge, Cerro de Pasco, Howe Sound, and, to lesser degree, Kennecott. For Andes, Chile, and Phelps Dodge, which give operating costs only against copper sold, and the remaining charges and income in full, the costs per pound as calculated become rather arbitrary figures, subject to minor change should more detailed information become available. However, with these facts in mind, copper production cost data are nevertheless of value to those interested in the copper industry.

In 1929, the unusual conditions prevailing in the industry made higher costs in general a foregone conclusion. With the rapid expansion of copper consumption in 1928, an increasing productive rate and strengthening price structure during the year culminated in the spring of 1929, to be followed by increasing curtailment and a stabilized price level. Under these conditions, that the increase in production costs in general should be relatively small may be surprising to many.

In an article published a year ago, cost data for 1928 were calculated for a number of representative American

Table I—Weighted Average Costs per Pound for Nineteen American Copper Companies

Year	Output Millions of Pounds	Debit: Operating Costs	Debit: Taxes and Interest	Debit: Depreciation	Credit: Sundry Metal Income	Credit: Miscellaneous Income	Credit: Miscellaneous Expense	Cost After Depreciation Before Depletion
1929.....	2,091	9.93	1.21	1.07	1.52	1.17	0.13	9.65
1928.....	2,150	9.32	1.19	1.02	1.54	1.02	0.11	9.08

Table II—American Copper-Mining Companies: Production Cost Data for 1929

Compiled by Mineral Research Corporation, 17 John St., New York City

All Figures in Cents per Pound of Copper Produced Unless Otherwise Stated

Company	Production Millions of Pounds, 1929	Cumulative Debits: Operating Costs	Cumulative Debits: Plus Taxes and Interest	Cumulative Debits: Plus Depreciation	Cumulative Debits: Plus Depletion	Cumulative Credits: Sundry Metal Income	Cumulative Credits: Plus Miscellaneous Income	Cumulative Credits: Minus Miscellaneous Expense	Cost After Depreciation Before Depletion	Cost After Depreciation and Depletion
Andes	(a) 130.5	7.42	9.06	10.09	.....	(s) 0.30	0.65	.....	9.44	.....
Calumet & Arizona	130.5	9.89	11.38	12.15	1.80		2.79	2.31	9.84	.....
Calumet & Hecla	123.8	8.71	(b) 10.34	11.71	13.35	.....	0.44	0.25	11.46	13.10
Copper Range	24.2	(c) 16.48	.....	.....	.....	.....	(d) 5.11	(e) 2.02	(f) 14.46	.....
Cerro de Pasco	99.9	(g) 19.36	(g)	(h) 21.57	(h) 24.89	11.88	13.56	.....	8.01	11.33
Chile	(2a) 212.6	4.74	(i) 7.75	8.88	.....	.....	0.98	.....	7.90	.....
Granby	60.8	12.32	13.27	15.53	16.82	0.73	1.42	.....	14.11	15.40
Howe Sound	43.0	27.20	28.34	30.65	.....	10.81	20.96	.....	9.69	.....
Inspiration	107.3	(j) 10.37	10.64	11.49	.....	.....	0.03	.....	11.46	.....
Kennecott	501.1	(k) 12.22	13.46	14.34	.....	0.61	(l) 6.70	6.56	7.78	.....
Magma	38.2	10.39	12.04	13.14	.....	2.48	(m) 2.85	.....	10.29	.....
Miami	58.8	11.06	11.75	12.47	.....	.....	(n) 0.49	.....	11.98	.....
Mohawk	20.0	7.04	7.83	8.23	9.04	.....	1.14	.....	7.09	7.90
Mother Lode	12.2	6.39	7.22	.....	.....	0.41	0.42	.....	(f) 6.80	.....
Nevada Consolidated	266.3	10.10	10.67	(o) 11.40	.....	0.51	1.24	.....	10.16	.....
Noranda	51.6	9.27	10.66	13.13	.....	2.94	4.00	(p) 3.17	9.96	.....
Phelps Dodge	(3a) 151.2	(r) 14.75	15.37	16.53	.....	(s) 0.51	(t) 4.13	.....	12.40	.....
United Verde Ext	64.1	8.47	9.70	9.81	14.26	0.84	1.39	.....	8.42	12.87
Utah	298.6	7.65	8.47	8.96	.....	0.97	(u) 1.10	.....	7.86	.....

(a) Represents sales; actual production was 162,663,775 lb.
(b) Includes selling and administration expense.
(c) Includes $675,000 railroad operating charge and other operating expense and taxes.
(d) Includes $899,000 railroad revenue and other operating revenue.
(e) Includes one-half Champion profits, or $633,000 to St. Mary's Mineral Land Company and $114,000 interest on railroad bonds.
(f) Before depreciation and depletion; for Copper Range this amounted to 2.8c. per pound in 1928.
(g) All operating expense and includes taxes.
(h) Charge allots 40 per cent to depreciation, 60 per cent to depletion assumed for total charge of $5,524,627.
(i) Taxes and miscellaneous charges; interest and discount on bonds.
(2a) Represents sales; production was 299,575,752 lb.
(j) Includes administration and federal taxes.
(k) Includes cost of metal products.
(l) Includes revenue from railroads, steamships and wharves, dividends and interest and estimated return from metal products less one-half Nevada Consolidated dividend.
(m) Includes profit from railroad after all charges.
(n) Does not include gain in sale of securities.
(o) Including $227,000 plant and equipment retirements.
(p) Includes $428,000 development and mining prior periods.
(r) Less $5,420,000 merchandise sales.
(3a) Represents sales; production including purchase ores, was 222,003,363 lb.
(s) Estimated credit, precious metal in own ores, based on percentage of sales to total production.
(t) Includes precious metals in custom ores, and estimated coal sales.
(u) Less one-half Nevada Consolidated dividend.

copper companies whose output represent nearly two-thirds of the production from North and South America[1]. The accompanying Table III has been prepared on the same basis and offers a means of comparison of costs in these years.

The figures in Table I represent the weighted average of costs per pound of copper for the nineteen companies listed in Table II. Several changes have been necessary to make the 1928 and 1929 costs strictly comparable.[2] In 1928, the cost per pound after all charges except depletion and including all credits was 9.08c. In 1929, this figure is 9.65c., an increase of only 0.57c. This seems small in view of the difference between the average selling price of copper in these two years, the higher wages prevailing in 1929, and the increase in costs due to curtailed operation. That costs were held to this level in 1929 speaks well for the copper industry as a whole.

Further examination of the 1928 and 1929 figures shows that the increase was almost entirely the result of higher operating expense, this becoming 0.61c. per pound higher. Increased wages form the largest part of this, but a factor which deserves mention is greater development and plant expense. Agreement between the remaining figures is surprisingly close. The items of taxes and interest vary by only 0.02c. Depreciation charges in 1929 increased by 0.05c. Sundry metal income shows little change between the two years, more or less of a coincidence with higher average prices in 1929 for lead and zinc and a lower one for silver. With miscellaneous income, an increase of 0.15c. per pound has been caused in large part by increased returns from investments and allied operations.

Table II contains the detailed 1929 costs for the companies whose totaled figures make up Table I. The 1929 costs per pound after depreciation and sundry credits, but before depletion, the figures usually published as the costs of production, have been listed by companies in the order of increasing cost in Table III. For the purpose of comparison the corresponding figures for 1928 are also given. Of the companies thus listed, five show slightly decreased costs. Kennecott, which has assumed first place as lowest cost producer, found necessary the inclusion of a credit from metal products in cost calculations, which caused a slight reduction in 1929 costs. The magnitude and efficiency of operations as practiced at Braden and Utah are well known, and

[1]"Analyzing the Cost of Producing American Copper," A. B. Parsons; June 8, 1929, issue of the *Engineering and Mining Journal*.

[2]In compiling the 1929 totals, the estimated value of Kennecott's metal products has been deducted from operating expense and miscellaneous income and taxes have been estimated where these figures are lacking. For the 1928 table, Andes, Chile, and Phelps Dodge have been recalculated on the basis of copper sold.

Table III — Per-Pound Cost After Depreciation and Sundry Credits But Before Depletion *(a)*

	Cents	
	1929	1928
Kennecott	7.78	7.81
Utah	7.86	7.29
Chile	7.90	7.98
Cerro de Pasco	8.01	3.69
United Verde Extension	8.42	7.53
Andes	9.44	10.83
Howe Sound	9.69	8.38
Calumet & Arizona	9.84	9.51
Noranda	9.96	11.00
Nevada Consolidated	10.16	9.42
Magma	10.29	9.75
Calumet & Hecla	11.46	10.67
Inspiration	11.46	11.13
Miami	11.98	12.04
Phelps Dodge	12.40	10.25
Granby	14.11	13.75

(a) Mother Lode, Mohawk, and Copper Range have been omitted from Table III.

even without the credit of profit from metal products, costs would probably have been only slightly higher. With the inclusion of one-half of the Nevada Consolidated dividend paid Utah, which was deducted from miscellaneous income, Kennecott costs would be lowered by 1.45c. per pound, putting it in a class by itself. Andes and Noranda, new mines which were not fully developed in 1928, showed lower costs in 1929, which were attributable, in part, to bringing to production increased plant capacity, a process completed only late in the year at Noranda. For Andes the taxes and interest item for 1929, which no longer includes discount on debentures, is decreased by about 1.5c.; depreciation increased by 0.60c. Noranda's operating cost was roughly one cent per pound higher in 1929; depreciation and miscellaneous expense charges were about two cents less. Chile, with a slight reduction in 1929 costs, shows the lowest operating expense of all of the companies listed. "Other income" increased by more than a million dollars in 1929, or 0.60c. per pound. Miami, operating at full capacity during the year, shows slightly lower costs, with little difference in any per pound charge.

Five companies show increased costs in 1929 less than the 0.57c. average for all companies. Of these, Utah, a subsidiary of Kennecott, with an increase of 0.47c. per pound, practically all attributable to increased operating expense, is the lowest-cost producer. Miscellaneous income, with half of the Nevada Consolidated dividend deducted, was about the same as in 1928. As the 1929 Nevada dividend was nearly double that of the previous year, crediting Utah's share would reduce costs 2.45c. per pound. Calumet & Arizona, as a result of the economies effected by consolidation with New Cornelia, records an increase of only 0.33c. per pound, a creditable showing which will be bettered under more favorable conditions. Magma and Inspiration likewise reflect capable management with only moderately increased costs, in both cases due principally to higher wages paid. Granby, always a high-cost producer, shows a moderate increase in 1929, a result caused not only by higher wages but also by treatment of lower-grade ore.

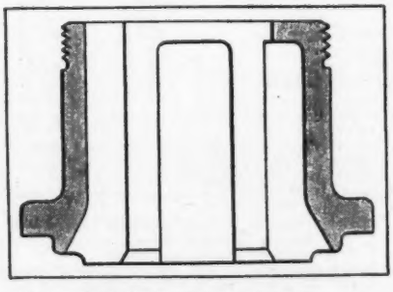
Of the remaining companies, Cerro de Pasco, with several extensive development projects under way, with over five million dollars more charged to operating expense in 1929 than in 1928, and with production only slightly larger, shows the greatest percentage increase. Even with this increase, Cerro stands fourth in the low-cost producers' ranks. Nevada Consolidated, with an increase of 0.74c. per pound for 1929, shows the effect of sharp curtailment in the latter part of the year. The financial statements of Phelps Dodge, which cover in condensed form the diverse activities of this large company, do not permit of ready analysis. Hence, the rather large increase in 1929 costs for this company may include unusual expense which cannot be segregated. United Verde Extension, with part of a large increase in production coming from custom ores, and with slightly lower grade to its own ores, shows 0.89c. per pound increase in 1929 costs. Howe Sound, with approximately the same copper production, shows a decrease in sundry metal income, caused by lower lead-zinc and silver output. Principally for this reason costs increased by 1.31c. The increase of 0.79c. in Calumet & Hecla's costs in 1929 was the result largely of increased operating expense.

■

Substitute for Cross-Hatching

THE LONG and tedious process called "cross-hatching" of sectional views on tracings can be shortened and made much less trying by substituting a shading done with the flattened end of a soft lead pencil on the back of a tracing after erasing the glossy surface of the tracing cloth or paper. The shaded portion of the accompanying cut illustrates the effect produced.

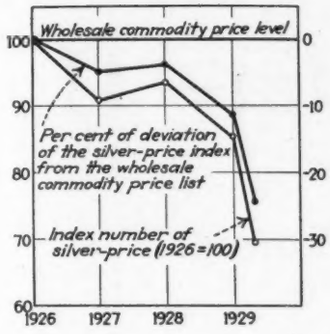
Blueprints from such tracings show up distinctly, the shaded section being halfway between blue and white, with a clear white outline, as usual. When changes are made on these tracings, the shading need not usually be erased, and therefore time is saved again over the ordinary method. Morton Schwam, in *American Machinist*.



Effect of pencil shading

The Silver Lining in Silver

Herbert M. Bratter



WITH bar silver at 33¼c. an ounce on June 21, another new low for all time was recorded. Already this year silver has recorded several new lows, and the remaining six months seem veiled in gloom. Things had been going badly enough for silver all through 1929. At the beginning of 1930 French Indo-China went off the silver standard. When the Indian government restored an import tax on silver, March 1, 1930, a cloud settled on the market. Frequent rumors of a similar step in China have persisted to date; and the Chinese government, though still permitting bar silver to enter the country unimpeded, has imposed a duty on imports of foreign silver coins. Meanwhile certain American producers are in favor of a duty on silver imports, silver mines are shutting down, and Mexican producers are considering ways and means of producing and selling silver manufactures.

Is there a silver lining to the cloud over the silver market? There is, although it is not very encouraging. The "silver lining" lies in the fact that silver has not declined quite so much as the drop in price would indicate. In other words, since all commodities have been declining in price, the real decline in silver has not been as severe as it seems. To take some simple examples:

(A). If commodity prices, as represented in the index number, record a decline of 5 per cent during a given year, while the silver price remains unchanged at 40c. per ounce throughout that year, the amount of commodities that silver will buy, per ounce, has really not remained unchanged but has increased.

(B). If commodity prices remain unchanged and silver declines 5 per cent in price to 38c. an ounce, the purchasing power of silver has diminished by 5 per cent.

(C). Now take a case where commodity prices decline 5 per cent, the index number declining from 100 to 95. At the same time the price of silver declines 5 per cent, from 40 to 38c. Silver at the end of the year is worth 38c. instead of 40c., as at the beginning of the year. But, since commodity prices have declined, 38c. gold at the end of the year will buy more in commodities than 38c. gold at the beginning of the year, for the purchasing power of gold has increased during the year. Therefore, the real decline of silver is somewhat less than 5 per cent. To state it another way, 38c. at the end of the year is worth about 105 per cent of 38c. at the beginning of the year—i.e., about 39.90c. That, in short, is the sunny side of the silver situation.

Now, what is the best way to measure the real decline and how does it compare with the apparent decline in silver since, say, 1926. That is a very convenient year to take, because silver, in September, 1925, was at the highest monthly average in about five years. Thereafter it started to decline. Also, the decline in wholesale commodity prices in the United States commenced in 1926. The date selected is convenient, moreover, because certain index numbers are based on 1926 prices as 100. In the following discussion the new low prices recorded by silver in May and June, 1930, when the market was erratic, will be disregarded. However, averages through April, 1930, will be considered.

The average price of silver in 1926 was 62.01c. per fine ounce in New York. During January to April, 1930, the average price as recorded by the Federal Reserve Board was 43.14c. The decline was thus 18.87c., or an apparent 30.43 per cent. Now, if an index number is made showing the silver price on the basis of 62.01c. (the 1926 price) as 100, the index number for the first four months of 1930 will be found to average 69.57, the decline still being 30.43 per cent. Now, to determine the purchasing power parity of silver in 1926 and 1930, one must compare its index number with the index number of wholesale prices for the same periods. For 1926, wholesale prices stood at 100. For the first four months of 1930 they averaged 91.75, a decline of 8.25, or 8.25 per cent.

Therefore, as shown in the foregoing, the purchasing power of gold increased over 8 per cent between 1926 and April, 1930; and the purchasing power parity of silver is therefore greater than appears from the silver-price index number. The real price of silver, then, may be shown not by giving the silver-price index number, but by calculating the relation of that index number to the index number of wholesale prices in general.

In 1926 both figures were 100, so the relationship is 100 per cent. In 1930 (first four months) the silver-price index is 69.57 and the wholesale commodity price index, 91.75. Since 69.57 is 75.83 per cent of 91.75, the real decline in silver has been not the 30.43 per cent given above, but 24.17 per cent, the difference between 75.83 and 100.

This calculation is based on the data shown in the accompanying table.

		1926	1927	1928	1929	Jan.-April 1930
I.	Price of silver in cents per fine ounce	62.01	56.38	58.20	53.00	43.14
II.	Index number of silver price (1926 = 100)	100.00	90.92	93.85	85.47	69.57
III.	Index number of wholesale prices in the United States	100.00	95.40	97.70	96.50	91.75
IV.	Relation of II. to III. in per cent	100.00	95.30	96.06	88.57	75.83
V.	Real decline in silver since 1926, in per cent	0	4.70	3.94	11.43	24.17

This relationship, for each year since 1926 and for the first four months of 1930, is clearly portrayed in the accompanying graph. The horizontal line represents the general level of wholesale commodity prices. The lower line shows the apparent decline in silver evidenced by the price in cents per ounce, or by the index number of that price. Between the two measures, the real decline in the price of silver is shown by the heavy declining line.

Improvements at New Cornelia—II

George J. Young
Associate Editor

The first part of this article, describing mining operations, the new coarse-crushing plant, and the dust-collecting system, appeared in the June 23 issue. In the present and concluding installment Mr. Young discusses the mill for concentrating sulphide ores, the leaching plant which has just been temporarily closed on account of low copper prices, the power plant, and the water supply.

THE DEGREE to which crushing and grinding are carried out is indicated in Table I which also gives the screen data for the leaching plant. General sulphide mill data, averaged from 20 days in April, are as follows: Ratio of concentration 16.222 to one; total copper in feed, 1.056 per cent, of which 0.048 per cent is oxide copper; per cent solids in flotation feed, 18.2; per cent copper in concentrates, 15.93; "insoluble," 43.6; iron, 18.3; moisture, 9.7; general tailing, 0.079 per cent total copper, 0.023 per cent oxide copper; recovery, 92.95 per cent total copper, 94.71 per cent sulphide copper, 55.83 per cent oxide copper; reagents used, pine oil, 0.343 lb., sodium xanthate, 0.083 lb., and lime, 0.917 lb. per ton; and fresh water, 372 gal. per ton of ore.

The flow sheet is as follows, the description applying to a single mill unit: Mill feed (60 to 120 tons per hour) passes a weightometer and is split between two 6x15-ft. primary rod mills, discharging into two 8x24-ft. Dorr classifiers, 70 per cent being returned to the primary and 30 per cent passing to the two secondary rod mills, which are in closed circuit with 8x24-ft. Dorr classifiers. Overflow from all four classifiers (5 per cent plus 65 mesh and about 60 per cent minus 200) goes to a header and automatic sampler and then to four primary roughers (19 ft. by 15 in. MacIntosh rotors), the tailing of which flows to four secondary roughers of the same type and size; tailings from secondary roughers pass to two MacIntosh scavenger machines and then flow past a sampler to a 200-ft. Dorr thickener, from which they flow to the tailing pumps and thence to the waste dump. All rougher and scavenger flotation concentrate is elevated by air lifts to two pairs of cleaner cells (12-ft. MacIntosh) in series with roughers, the concentrate from the first pair being recleaned upon the second pair; the tailing from both flows to the primary roughers and the final concentrate from the second pair of cleaners flows to thickeners and thence to Oliver filters. The capacity of a unit is about 1,800 tons per day, but flotation capacity is from 2,400 to 2,600 tons per day per unit. Mill capacity (eight units) is estimated at from 15,000 to 16,000 tons daily. The general plan of a section is shown in Fig. 5.

The reconstruction program involved lengthening the rod mills in the original five sections by 3 ft. to a nominal length of 15 ft. and to an actual length of about 16 ft., the inside diameter being nominally 6 ft. Flotation cell capacity was doubled and MacIntosh cells were substituted for Inspiration type. Three new sections were constructed and, in addition, a 400-ton experimental mill is being completed. The experimental mill provides for primary desliming classifiers, the discharge going to straight flotation or to primary grinding (5x10-ft. rod mill) in partial or complete closed circuit with rake classifier, followed by a ball mill (8 ft. by 36 in. Hardinge) in closed circuit with another classifier; and then by a bowl classifier, the overflow going to flotation and the oversize to the ball mill. The arrangement is such as to make a number of combinations feasible and to provide for regrinding and re-treatment of concentrates.

Mill-bin ore storage has been increased to 16,000 tons and storage in the crushing plant to 30,000 tons, making a total future available storage of 46,000 tons for the whole plant. An additional tailing settling tank, 275 ft. in diameter, was constructed of reinforced concrete. The carbonate bin extension required 189 tons of structural steel and 1,000 cu.yd. concrete; the intermediate surge bin addition, 241 tons structural steel and 1,055 cu.yd. concrete; three mill units, 810 tons structural steel and 6,170 cu.yd. concrete, 40,000 cu.yd. fill and 917 cu.yd. concrete in floors; and fine crushing and fine-crushing conveyor system required 511 tons structural steel. The total concrete was 16,600 cu.yd., with 1,250 tons reinforcing steel. About one year was required for the completion of the construction program.

Rod mills are driven by 300-hp. synchronous motors (150 r.p.m.; mill, 17 r.p.m.); feeder belts, 5-hp. motors and speed reducers; 42-in. feeder belts under three chutes on each side of center of mill section driven by 2-hp. motor with street-car controllers; 7½-hp.

Table I—Screen Sizes and Percentages

Screen Sizes	Leaching Plant Feed	Feed to Screen Plant	Feed to Roll Plant	Mill Feed from Screen	Flotation Feed	Flotation Tailing	Flotation Concentrate
+ 0.742 in.	....	....	2.6	....	....	....	....
+ 0.525 in.	0.2	2.0	7.7	....	....	....	....
+ 0.371 in.	3.9	2.6	21.8	....	....	....	....
+ 3 mesh	12.7	8.4	16.9	0.1	....	....	....
+ 4 mesh	15.0	27.8	28.9	4.0	....	....	....
+ 6 mesh	12.0	23.7	14.5	23.4	....	....	....
+ 8 mesh	8.9	9.7	2.6	17.4	....	....	....
+ 10 mesh	8.7	6.0	1.0	13.1	....	....	....
+ 14 mesh	6.5	3.4	0.5	7.9	....	....	....
+ 20 mesh	4.9	2.4	0.3	5.6	....	....	....
+ 28 mesh	27.2	1.8	0.1	4.4	....	....	....
+ 35 mesh	....	1.4	0.1	3.3	....	....	....
+ 48 mesh	....	1.3	0.1	2.9	0.8	0.7	0.7
+ 65 mesh	....	1.1	0.1	2.4	3.8	4.1	5.4
+ 100 mesh	....	8.4	2.8	15.5	13.2	12.7	14.8
+ 150 mesh	....	....	....	....	15.8	15.3	18.5
+ 200 mesh	....	....	....	....	11.3	11.9	11.8
— 200 mesh	....	....	....	....	55.1	55.3	48.8

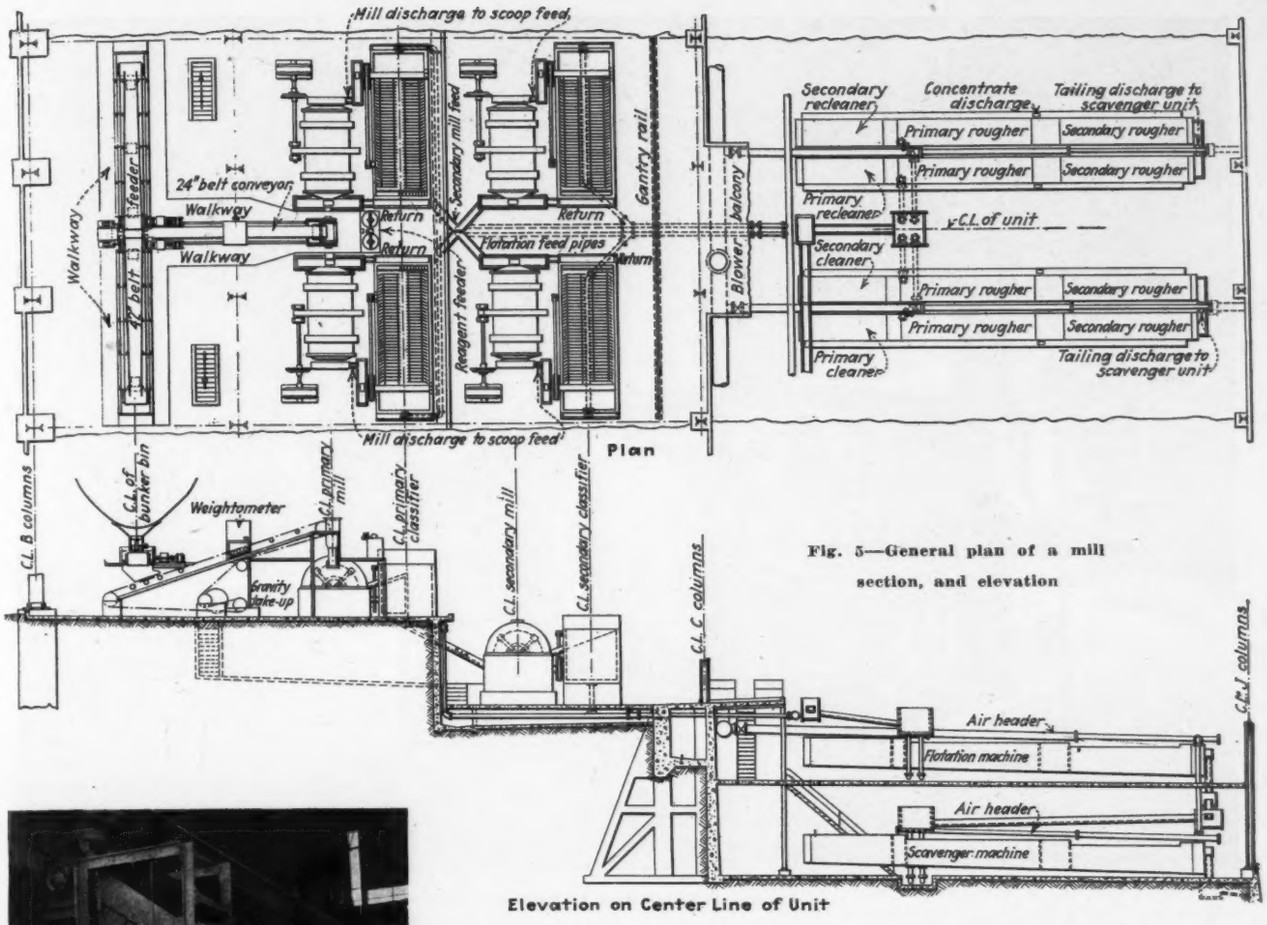
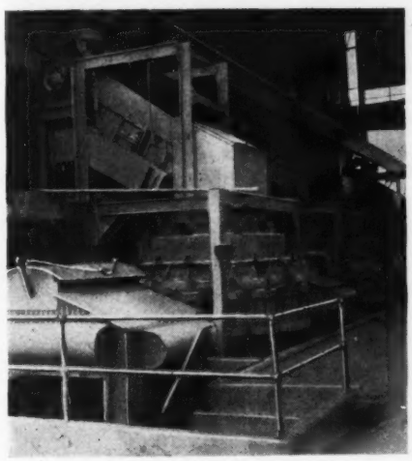


Fig. 5—General plan of a mill section, and elevation



Suspended magnets and magnetic pulleys remove tramp iron from the ore delivered to disk crushers

air for air lifts supplied by three Ingersoll-Rand compressors, 150-hp. motors; flotation air supplied by two De Laval units, each of 20,000 cu.ft. (5 lb.) air and each driven by 650-hp. motors. Power consumption is 9 kw.-hr. per ton for grinding; classifiers, 0.23 kw.-hr. per ton; flotation, 2 kw.-hr. per ton; feeders, 0.04 kw.-hr. per ton; motor-generator sets for field excitation, 0.85 kw.-hr. per ton; crushing plant, 54-in. gyratory, 0.09 kw.-hr. per ton; rolls, 0.75 kw.-hr.; Symons cone crushers, 0.65 kw.-hr.; conveyor system, 0.6 kw.-hr. per ton; total crushing, 2.09 kw.-hr. per ton; and fine grinding and flotation, 11.27 kw.-hr. Total power is 17 kw.-hr. per ton.

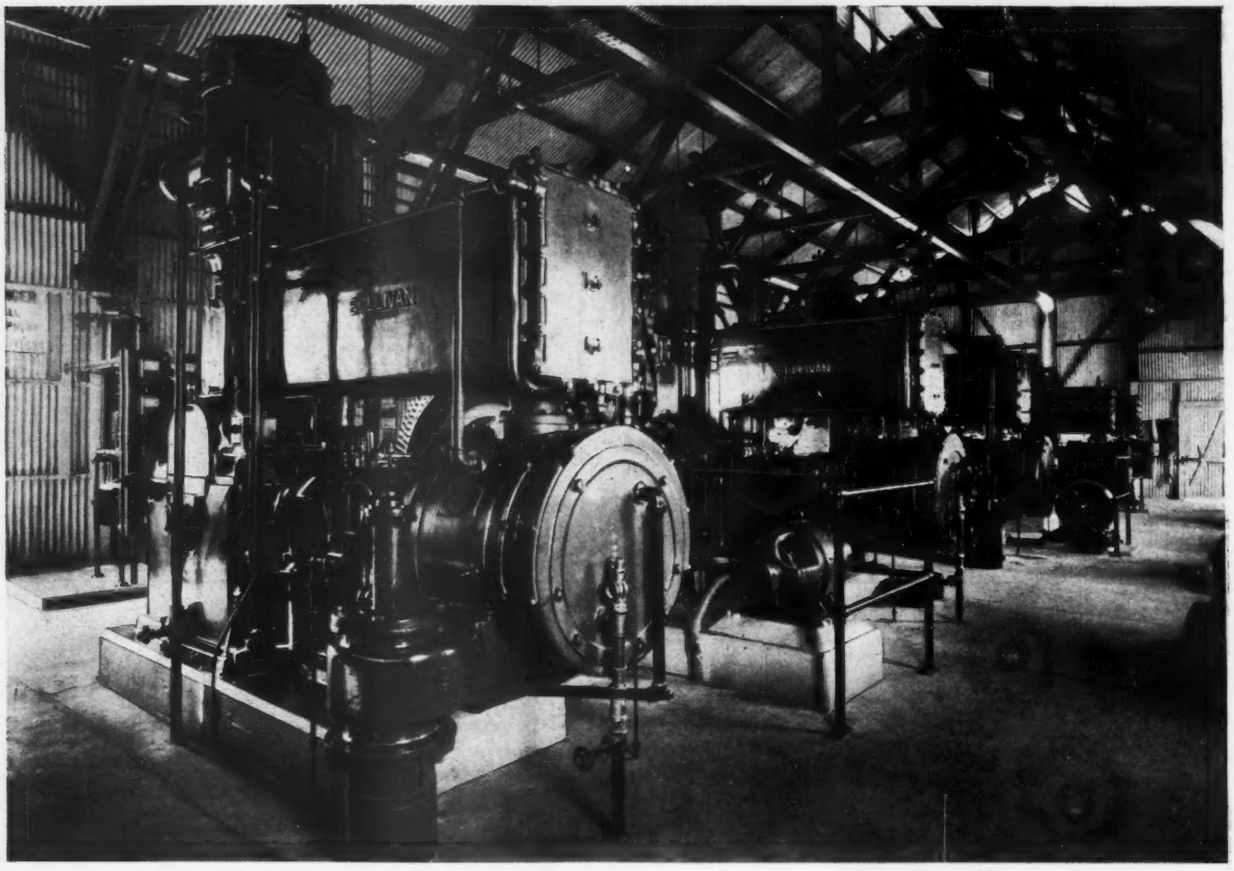
The mill is equipped with three traveling cranes—a 50-ton part gantry and a 20-ton and a 5-ton over the shop area. MacIntosh cells are designed to give 3½ sq.ft. rotor area per linear foot, or 532 sq.ft. on the eight roughers and 168 sq.ft. on the four cleaners per unit. Air consumption is 7 cu.ft. per square foot for roughers and somewhat less for cleaners. Total air consumption per unit is 3,724 cu.ft. at roughers and 1,008 cu.ft. at cleaners, or a total of 4,732 cu.ft. per minute.

Water ratios are as follows: rod mill discharge, 70 per cent solids; classifier overflow, 25 per cent solids; tailing, 22 per cent solids. Lime is fed to rod mills and an 8.6 to 9 pH value is maintained. Sodium ethyl xanthate is added at primary classifier overflow and pine oil in sufficient amount to maintain froth at the feed of the flotation roughers. Return water is pumped by three 3,000-g.p.m. De Laval single-stage centrifugals against a 150-ft. head (150-hp. motor) to a reservoir. At the tailing dam a 1,200-g.p.m. single-stage De Laval pump (75-hp. motor) placed upon a barge also returns excess water. Tailing is pumped by four 8-in. Wilfley sand pumps (100-hp. motors) a distance of 5,500 ft. against a 40-ft. head, including friction, through a wooden stave pipe, 12 to 15 in. in diameter.

One of the most interesting features of the sulphide mill is the gravity oil system for lubricating the rod mills. A supply tank suspended above the rod-mill floor supplies lubricating oil through a pipe system to all bearings, and the oil returns to a Bowser oil filter, where it is heated by a heating element, filtered, and pumped back by a Viking oil pump to the supply tank. Gyratory, Symons cone, and roll crushers are also equipped with gravity oiling systems. Classifiers and feeder belts in the mill are lubricated by Alemite fittings and grease gun.

Mantles of the primary crusher wear from eight months to one year; concaves are good for five months when they are set out and last another five months. Rolls have been in operation about six years and are rebabbitted at intervals of eighteen months; cheek plates last two years; sometimes adjusting nuts freeze on and the nut is cut on a diameter and bolted upon plate covers and reused; only one brass bushing on the fleeting device has been replaced; roll steel wear averages 0.126 lb. per ton.

End and breast liners of the rod mill, of manganese steel, last from twelve to eighteen months; manganese steel liners are used, and when worn out are cut up for chute linings. Rods are 1 per cent carbon with 1 per cent manganese, 3-in. diameter in primary and 2½-in. diameter in secondary mills; rod wear is 2.3 lb. per ton of ore. Rod-mill liner wear is 0.32 lb. per ton.



Compressor installation at the open pit

Heat-treated liner bolts have proved efficacious in reducing replacements to a minimum and greatly increase effective running time. No replacements of pinions and only four replacements of ring gears have taken place in six years. Only four bearings out of 160 have been replaced in six years. Feed scoops of cast iron last six years and lip or shoes of manganese steel last 2½ years. In the aggregate there is unusual use of manganese steel for apron plate feeders, rod-mill liners, crusher wearing parts, and in other places.

Sand launders are trough shaped and are made of white cast iron, cast thicker on the bottom than on the top. They are used for classifier discharge returns to rod mills. All other launders are made of redwood and are lined with 1x6-in. cross pieces, held down by 1x6-in. side strips. Wooden liners are replaced twice a year. Experiments are about to be started with rubber lining. Air lifts give little trouble.

Endless leather belting drives are used on classifiers and feeder conveyors. They give an average life of four years. Speed reducers upon feeders have required no replacements. Belt conveyors are purchased upon the basis of performance and some twelve manufacturing companies' products are in use. Dreadnaught riveted fasteners are used on 24-in. belt conveyors and on wider belts, Flexo-plates, countersunk on both sides and placed on a diagonal splice 20 to 30 deg., are in use.

An excellent system for facilitating mill control work has been installed. Weightometers maintain the tonnage rate, which is dependent upon the hardness of the ore. The objective is 5 per cent on 65 mesh and as much through 200 mesh as possible with that grind. Xanthate is fed at a constant rate so long as the ore remains uniform. The pH test is made once an hour upon a composite of the whole mill, and sometimes a single section is tested. A sample head on each section is cut every twenty minutes by automatic samplers, likewise the tailing on each section. Composite samples are made up for each shift. Final concentrate sample cuts are taken at ten-minute intervals and a composite made each shift. Concentrate cars are hand-augered for moisture and assay samples. The mill crew, excluding crusher and fine-grinding plants, consists of fifteen men including three mill operators, two oilers, two flotation operators, five flotation helpers, and three cleanup men. In addition three men are employed in the daytime and two at night at the filters, and in the daytime two men loading concentrates.

As in other plants there is the tendency to reach a greater and greater proportion of minus 200 mesh or to grind finer. The research department improved recoveries by 5 per cent and cut reagent cost in two by changing from sodium carbonate, sodium sulphide, and a coal tar reagent, to lime, xanthate, and pine oil. The tailing content was cut in half. Present practice is to grind down for a minimum tailing. Plant improvements increased tonnage in the crushing division and provided a better and finer product for the rod mill thus giving an increased tonnage through the fine-grinding units, by reason of larger mills and increased classification capacity. The mill capacity was doubled by the addition of only three new units. In the end higher recoveries were attained at lower milling costs.

Leaching Practice

After thirteen years in operation, the leaching plant has about a year's supply of carbonate ore in sight, with probably more to come as exploration work continues. Both the plant and the practice have been described before and it is unnecessary to repeat such descriptions. During April the average content of the leaching plant feed was 0.861 per cent copper, of which 0.796 per cent was soluble copper. A screen analysis of the feed is given in Table I. Recoveries were 84.12 per cent, representing 88.9 per cent soluble copper and 55 per cent sulphide copper. Alumina continues to be the greatest acid consumer and it is necessary to discard some solution to keep the iron-alumina content under control. Acid consumption is 35 lb. of 60 deg. Bé. acid per

ton of ore, or about 2 lb. per pound of copper recovered. The average for 1929 was 1.96 lb. acid per pound of copper recovered. This applies to the acid purchased, as about half of the acid used is regenerated in the plant. A ton of pyrite burned in the roasters to provide sulphur dioxide used in the towers to reduce ferric to ferrous salts in the electrolyte, makes an equivalent of a ton of 60 deg. Bé. acid. Ampere efficiency is 75 per cent. Current consumption is 1.299 kw.-hr. a.c. at power house switchboard per pound of copper, with conversion losses around 20 per cent. All cement copper is shipped to the Douglas smelter. Life of anodes is thirteen years and by the use of a current density of 6 amp. per square foot, peroxidization is negligible. Current density in depositing copper is 4 amp. per square foot. Electrolyte contains 1.75 per cent copper; total iron, 1.60 per cent, of which 0.2 ferric iron is reduced to 0.05 per cent; 1.5 per cent acid in solution. Scrap loss is less than 1 per cent. Scrap copper is shipped with the sheets. The leaching time has been extended to fifteen or sixteen days, against 8 days formerly, and acid consumption has been cut 50 per cent. Two roasters are operated, treating 30 tons of pyrite per day. Circulating solution on a 5,000-ton tank charge is 4,000 g.p.m., and 1,000 g.p.m. is advanced from vat to vat. Treatment rate was 90,000 tons per month up to the date of closing. Tailing contains 0.13 per cent copper, of which 0.04 per cent is sulphide copper. Tailing as high as 0.35 per cent is obtained when chalcocite is present in the ore. After a service extending for six years longer than its previously estimated life, the present plant is in excellent condition, attesting the sound engineering in the beginning and the conscientious maintenance by its operating staff.

Ajo has no power advantages. Oil fuel is transported and used in ten Stirling boilers which supply 250-lb. steam for three 7,500-kw. turbine units, two of which operate at 1,800 r.p.m. and one, recently installed, at 3,600 r.p.m. The power plant has been operating for more than thirteen years and is in excellent condition. Direct current for electrolytic precipitation is supplied by four double-end motor generators giving 4,000 amp. at 170 volts at each end; ordinarily, 5,200 kw. is supplied, but the load was recently reduced to 2,600 kw. Fuel oil is stored in three 15,000-bbl. steel tanks. The average power-plant load before the leaching plant was shut down was 9,200 to 10,000 kw. Average kilowatt-hours per barrel of fuel oil was 290.4 during 1929. A cooling pond, 200x600 ft., takes care of condenser water. The boiler water is excellent.

Two 500,000-gal. steel tanks contain the fresh water supply for the town and the plant. A mill reservoir excavated in rock and then gunited provides storage for 1¼ million gallons. A system of thickeners insures return of surplus water used in milling and the average consumption of water in the sulphide mill is 300 gal. per ton (average during April). Water is supplied from underground workings at well No. 1, 6¾ miles north of Ajo. Two two-compartment shafts were sunk and connected by a gallery, 14x12 ft. inside timbers, from which six pump chambers each 19 ft. wide, 15x47 ft. were cut. The floor of the pump station is 646.6 ft. from the surface. The shafts extend below the pump chamber; from shaft No. 1, 4,000 ft. of drifts, and from shaft No. 2, 410 ft. of drifts penetrate the water formation. Five double reciprocating pumps (three Worthingtons and two Prescotts) directly driven by 525-hp. synchronous motors operate against a 1,183-ft. difference of elevation and supply water to 10-in. and 20-in. pipe lines at the surface.

The pumps draw from two overhead sumps which receive their supply from three deep-well centrifugal pumps at No. 2 shaft. At No. 1 shaft are two 3,500-gal. centrifugal deep-well pumps. The Prescott pumps have a plunger displacement of 989 g.p.m. at 100 r.p.m. and the Worthingtons 1,325 g.p.m. at 72 r.p.m. In addition, a Byron Jackson multi-stage centrifugal, driven by a 500-hp. induction motor, elevates 1,800 g.p.m. to the surface from the water development workings. Total pump capacity is about 6,000 g.p.m. Combined flow from No. 1 and No. 2 shafts is estimated to be 4,534 g.p.m. Water development is being continued. The pump chambers and connecting gallery are fireproofed. Water temperature is 105 deg. F. and the water has an exceptionally low content of solubles. The water-bearing formation is a vesicular lava which represents an extensive former surface flow now submerged by erosional débris. It is unique in many ways. Water was first discovered by sinking a churn drill hole close to the principal surface drainage of the near-by region, which is typically arid.

The Ajo enterprise is worthy of study by both young and mature engineers. It is a clean-cut exemplification of good engineering and the advantage of modern mechanical equipment. Research solved practically all the initial problems and has since kept pace with changing conditions. Conservative leadership at the start and wisdom in selecting and maintaining an excellent operating personnel were conspicuous elements in its success. The present personnel, to whom I gladly acknowledge my indebtedness for their generous assistance in making this article possible, comprises M. Curley, manager; W. L. Du Moulin, general superintendent; J. A. Porter, plant superintendent; H. A. Nelson, assistant plant superintendent; H. W. Snyder, assistant leaching plant superintendent; G. R. Ingham, mine superintendent; G. A. Bell, chief chemist; C. T. Williams, engineer; and J. G. Bell, mill metallurgist.

Addendum—Tramp iron is removed in the Ajo mill at several points of flow of the ore. The suspended magnets used are of the Cutler-Hammer type, and the head of each conveyor delivering to the cone crushers is equipped with a Stearns magnetic pulley supplied by the Magnetic Manufacturing Company, of Milwaukee, Wis.

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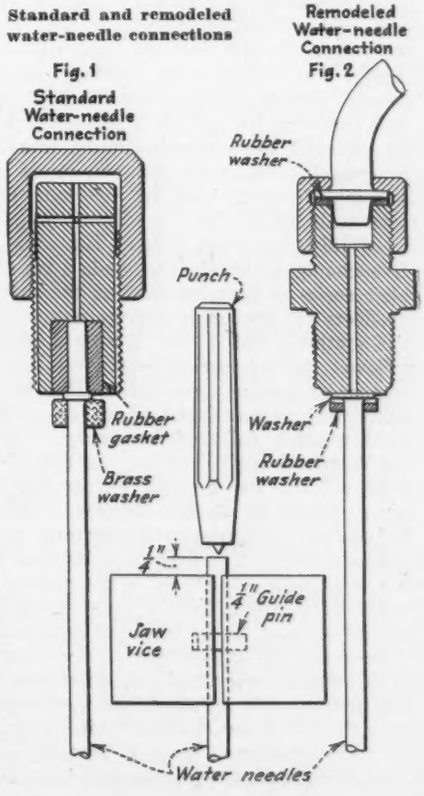
Remodeled Connection Improves Drifter

IMPORTANT economies have been effected at the Utah-Apex mine, at Bingham, Utah, with a remodeled water-needle connection for drifters, according to E. Morton, master mechanic. This connection, which is shown in Fig. 2, has been in constant use for the last seven years. It prevents water from entering the interior of the drill, and reduces clogging of the water-needle. The stream of water is introduced directly into the needle, as compared with the standard method illustrated in Fig. 1. Frequent replacing of needles and packing is also avoided. The water hose "L" and the nut are standard fittings purchased from the factory, and the spud is made of mild steel at the company's machine shop. A jaw vice with guide pins, and a specially designed punch, are the only tools required to produce the flange end of the water-needle. This end is heated by means of an acetylene torch and hammered down gradually.

Standard and remodeled water-needle connections



COMMENT AND CRITICISM

Cyaniding Carbonaceous Ores

To the Editor of "E.&M.J.":

After reading the interesting paper on the metallurgy of the Mother Lode of California carbonaceous ores by Messrs. Leaver and Woolf, of the Reno experiment station, recently published by the U. S. Bureau of Mines, I should like to make a few comments thereon.

The ordinary reader would gather the impression that the method they describe is a novel and hitherto untried one, and also that, so far, no known method has been commercially profitable for treating the slime from these ores. For instance, the statement is definitely made on page 5 of the pamphlet that "direct cyanidation of the tails is not practical," though the authors are aware that for the last six years the entire tailing product of the Argonaut mill, both sand and slime, has been treated by direct cyanidation in the plant of the Amador Metals Reduction Company—the slime after pre-oiling on the lines of the Silver-Dorfmann process, and the sand by percolation, sometimes with and sometimes without pre-oiling.

The line of treatment suggested in the pamphlet is not a new one by any means, and if there be any novelty contained in the authors' investigations it will be principally in the use of improved reagents for the flotation, resulting in a better ratio of concentration; that is, in concentrating the gold in a smaller bulk of material than was formerly found practicable. This they seem able to have accomplished, at least on the laboratory scale.

In July, 1916, the firm of Hamilton, Beauchamp & Woodworth made a complete series of flotation tests on the mill products of the Dutch-Sweeny mine on the southern end of the Mother Lode, followed by a general report on that company's milling operations. This resulted in a recommendation in favor of amalgamation followed by flotation of the entire tailing. Toward the end of 1918 a plant was erected, on the lines of this report, by Messrs. Bradley, Bruff & Labarthe, which started operating in January, 1919. The extraction by flotation was about 92 per cent of the content of the plate tailing, but the ratio of concentration was rather low, the concentrate averaging only about 17 per cent of the original weight of ore. However, the process was operated satisfactorily until the ore reserves in the mine gave out, necessitating a general shutdown. The concentrate thus produced was shipped to the smelter; but, toward the end of the period, owing to the rather large proportion and consequent low gold content of the concentrate, I made a long series of tests on its cyanidation, as an alternative to shipment to the smelter. Preliminary roasting was tried, of course, and gave good results, but a method of raw treatment was worked out that seemed likely to give a better economic return. This consisted of a series of three or four very short agitations in cyanide solution with filtration and washing between each. The results obtained in small-scale tests were completely confirmed on a tonnage basis, but the mine was shut down before the process could be applied at the mill.

Another important mine on the Mother Lode, the Shawmut, for several years used flotation after plating in its mill, the sand being tabled and only the slime floated. The concentrates from both were then mixed and roasted and the calcine was cyanided. This mine also is now shut down.

At the Argonaut, the California Slimes Company, predecessors of the Amador Metals Reduction Company, tried flotation in 1921 on the full working scale for several weeks and erected a furnace for roasting the resulting concentrate. In this case, however, the process was abandoned before the roasting stage was reached, and the chief reason seems to have lain in the changeable character of the Argonaut slime, so that any given set of conditions in flotation would not hold good for more than a day or so, or perhaps only for a few hours.

The characteristics of the ore in this northern section of the Mother Lode are not so uniform as might be supposed. We find this in cyanidation. For instance, tests made on the Plymouth slime showed that cyanidation, either with or without pre-oiling, would not yield more than a small percentage of the contained gold, whereas current slime from the Kennedy gave as high as 80 per cent by straight cyanidation without pre-oiling. This difference would appear not to depend on the carbon content; the analyses by Messrs. Leaver and Woolf show the same amount of carbon present in the slimes of both mines. In the Argonaut slime, which we have been treating by the pre-oiling process, we note marked differences in the amenability to treatment from day to day, though no difference in appearance is visible to the eye. Again, the authors of the paper state that the sand can be cyanided easily by straight percolation, but this is not universally the case, though true in the main. For instance, at times in the treatment of the Argonaut sand a small degree of pre-oiling has been found beneficial, though for the last twelve months this has not been necessary. The Central Eureka sand, on the other hand, showed in several tests made by us that only a poor extraction could be made by percolation without pre-oiling.

One question, which arises from the Leaver and Woolf investigation and does not seem to have been answered in the report, is whether or not the return of the middling to the circuit in mill operation would result in an increase in the gold content of the final tailing. It almost invariably happens that in the intensive re-cleaning of a flotation concentrate to produce a high ratio of concentration, involving a return of the middling to the head of the circuit, the original percentage of extraction shown by a primary test is not found to be maintained.

It was in consequence of the difficulties encountered by the California Slimes Company in flotation that the Amador Metals Reduction Company, on taking over the business, decided to try to work out the problem from another angle. In this it was fairly successful, but not so much so as to preclude consideration of any process that seems to offer a better economic return.

We have carefully analyzed the figures given in the Leaver and Woolf report and have concluded that if these data can be reproduced on the full tonnage scale over a period sufficient to allow for fluctuations in the character of the ore the method would be likely to yield a better profit than that of our present practice, and it would seem worth while to reopen a question which we had considered at least temporarily closed in regard to the beneficiation of the Argonaut slime.

E. M. HAMILTON.

San Francisco, Calif.

To the Editor of "E.&M.J.":

The article Mr. Hamilton refers to is an abstract from a Bureau of Mines Technical Paper now in the course of publication. The longer article contains a bibliography covering Mother Lode metallurgy and more details of the author's work.

Due mention is given the Amador Metals Reduction Company and its

sole use of the novel pre-oiling of carbonaceous portions of their ores prior to cyanidation. Without the pre-oiling, direct cyanidation is not satisfactory.

Our improved flotation results are due to the rapid advancement in flotation practice, particularly since the introduction of the xanthates. The results given are average figures based on a series of flotation tests in which the middlings from each test are added to the next test following the general procedure of practical operation.

Emphasis is placed on the low-temperature roasting of the concentrates. They contain arsenic minerals. At temperatures above 600 deg. C. arsenic readily unites with iron, which prevents the cyanide dissolution of gold.

As the refractory gold is associated with both the carbon and the sulphides, they must be removed from the sand portion, to obtain maximum extraction, before the sand is treated by cyanidation. Different mine ores or different grades of ores from the same mine may require finer crushing to free the refractory minerals for their removal by flotation.

Reno, Nev. EDMUND S. LEAVER.

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To Stimulate the Consumption of Silver

To the Editor of "E.&M.J.":

In the editorial in the issue of Jan. 23, entitled, "Stimulating the Demand for Silver," it seems to me you have pointed out or touched upon every avenue of escape from the present demoralized situation of silver. However, let me submit one proposition that you nearly mentioned in the second paragraph, in which you said: "A decade or less ago the price of brass or bronze ornaments, of utensils and knickknacks, bore no relation to the cost of the metals used in their manufacture, but since then the producer has taken an interest in merchandising to the final consumer . . . which of course greatly increased the consumption by placing it on the market at somewhere near reasonable prices. And so with silver. We must find some means of consuming our surplus."

Suppose we try to do something through our school systems? Manual arts are taught in every high school and in many junior colleges throughout our country. The students are taught the use of machinery, the use of tools, the art of making all sorts of articles and implements from wood, steel, iron, brass and copper. Why not introduce silver?

With this idea in mind I had an interview recently with one of the instructors of mechanics in the high schools of one of the largest cities in California. This teacher told me that he had just been visiting various schools within his jurisdiction, and had found in a few places instruction in a course in the art of making all sorts of utensils, ornaments and knickknacks from copper and brass. He also stated that the students were bubbling over with enthusiasm. The instructor in this art had far more applicants than he could accommodate. And why? Because the students were allowed to take home the beautiful ornaments they had made with their own hands. The students or parents pay for the material, and the boys or girls keep what they make.

What objection could there be to allowing students to hammer out or mold silver articles just as they do with brass or copper? Don't you suppose that when students became proficient in this art with copper or brass, they would far more desire to make ornaments out of silver? Then, to go a step further, they could dip them in paraffin, trace out any desired design on the surface and inlay it with gold. Aren't there tens of thousands of parents who would not hesitate to purchase a few pounds of silver that their own children might make something of ornamental beauty to adorn their tables, shelves, or pianos? To my mind something of growing importance might be accomplished through this sort of procedure, for two reasons, in particular.

The articles so made would not be placed upon the market, and consequently would not be in competition with manufactured goods. The silver would be purchased in the open market in the same manner as we purchase copper or brass. The time consumed in the making is provided for in the schooling; and the labor, a pastime and joy.

Can this one thing be accomplished? If so, imagine what it might mean. Why not organize? THOMAS HOLMES.

San Bernardino, Calif.

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Canada's Gold Production

To the Editor of "E.&M.J.":

Coincident with Mr. H. A. Kursell's article, "World Gold Supply to Dwindle," in your issue of June 23, is a paper, "Can Trade Live Without Gold," in the July issue of *Nation's Business*, by Mr. Hartley Withers, who is apparently of the opinion that any shrinkage in gold production will be no calamity.

Mr. Kursell refers rather tersely to the increasing Canadian gold output, which is forecast by those who should know as likely to exceed that of the United States in 1930, placing Canada in second place as a world producer. Mr. Kursell makes no reference to the gold producing properties of Kirkland Lake—Lake Shore and Teck-Hughes, the combined output of which for 1929 exceeded $10,000,000 (or more than 25 per cent of the Canadian production), from 750,000 tons milled. The 1930 output from these two properties will be considerably larger, because of increased milling capacities as well as the likelihood that higher-grade ore will be treated. Lake Shore will increase output from 1,350 to 2,000 tons per day, and Teck-Hughes has begun construction of a new unit (350 tons), which will permit a total daily milling capacity of 1,250 tons. The combined yearly gold production of the two companies may then reach $20,000,000.

Ontario Department of Mines figures of recovered grade of ore for the first quarter of 1930 unless otherwise stated. emphasize the importance of the Lake Shore and Teck-Hughes mines: Teck-Hughes, $17.21 per ton (for March, $17.50); Lake Shore, $14.07 (for March, $17.20); Wright-Hargreaves, 11.50; Sylvanite, 9.59; McIntyre, 8.86; Kirkland Lake, 6.88; Hollinger, 6.42 (for March, 6.50); Dome (for 1929), 7.89.

LESTER W. STRAUSS.

New York, N. Y.

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Idaho Opposes Nordbeck Bill

To the Editor of "E.&M.J.":

The editorial, "Mining Claims in National Forests," issue of June 7, is to the point. The Idaho decision mentioned was published in our report for 1928. We should be glad to send copies of this report to anyone interested.

That you may know that Idaho is at least partly awake to the situation, I am inclosing copies of letters recently addressed to our Senators and Representatives. STEWART CAMPBELL.

Boise, Idaho.

COPY OF LETTER SENT TO SENATORS BORAH AND THOMAS

"Information reaching this office from South Dakota is to the effect that all of the mining interests in that state are unalterably opposed to the Nordbeck Bill, S. 3774.

"It is my opinion, founded upon nine years' experience as Inspector of Mines, that the Forest Service desires such legislation for every forest reserve in the United States, and that this measure is merely an entering wedge toward gaining this end. This is clearly indicated in Mr. E. A. Sherman's memorandum to accompany report on the bill, Senate Calendar 366. This contained statements with which I cannot agree.

"Of course it goes without saying that such a law would immediately kill all mining on forest reserves, and that it would be bitterly opposed by everyone in Idaho who is interested in mining and the development of the state's mineral resources."

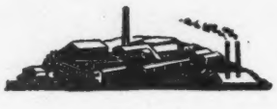
COPY OF LETTER SENT TO REPRESENTATIVES SMITH AND FRENCH

"Inclosed is a copy of a letter which I recently addressed to Senators Borah and Thomas, concerning Senate Bill No. 3774.

"I am calling this letter to your attention, as Senator Thomas, under date of June 5, advised me that this bill has passed the Senate.

"It is my opinion that this measure is pernicious legislation, as far as the mining interests of the state are concerned."

INDUSTRIAL PROGRESS



Oliver Unit Adapted to Filtering Granular Concentrate

AT THE West mill of the Bunker Hill & Sullivan Mining & Concentrating Company, Kellogg, Idaho, a 2½-ft. by 1-ft. (face) Oliver filter was installed to handle granular lead and iron table concentrate. It is now handling a large tonnage (maximum 100) satisfactorily. The filtering surface is Palma twill cover held by wire spaced 1½ in. A 10x18-in. Connersville exhauster is direct-connected to the filter by an 11-in. vacuum hose and at 180 r.p.m. has a volume capacity of 450 cu.ft. per minute. The filter is driven by a 2-hp. motor through an Oliver speed reducer shown in Fig. 1. Feed is delivered at the top of the drum by a drag classifier, and the concentrate is discharged by a scraper upon a conveyor belt beneath the filter.

Fig. 1 — Discharge end and speed reducer drive of Oliver filter handling granular concentrates

Fig. 2 shows the general arrangement. The horizontal part of the classifier box is 12 ft. long by 3 ft. deep, 41 in. wide at the top and 17 in. wide at the bottom. The inclined drain box is 12 ft. long and slopes 6 in. to 1 ft. In the drag the pulleys are 4 ft. in diameter by 12-in. face. The drag is an endless belt having 4-in. angle iron rakes at 18-in. centers; belt travel is 30 ft. per minute. The feed chute, Fig. 3, is so placed as to allow the concentrates to contact upon the drum, as the sections come under vacuum, a piece of 4-ply belting making the seal between the drum and the chute and more or less compacting the cake as the drum revolves. A "flapper" strikes the belting seal, or drag, at intervals and materially assists in securing a compact cake. It was found to be impossible to hold the cake upon the drum without the use of the flapper device.

Operating data are as follows: Feed, 34.3 tons lead and 20 tons pyritic concentrate (dry weight) from tables per 24 hours; 160 g.p.m. water inflow to drag classifier feeding concentrates from receiving sump; 0.289 g.p.m. filtrate through Connersville exhauster; feed from drag to filter 9.9 to 10 per cent moisture; moisture in discharged cake 6 to 7 per cent; thickness of cake 1 to 1½ in.; speed of drum 1.5 min. per revolution; vacuum 15 to 17 in.; total power for exhauster, drag, and flapper, 14.1 hp. No "blow" is used, and the filter cake is under vacuum throughout almost a whole revolution. One section of the valve is bridged just ahead of the point where the feed is received, and the scraper, shown in Fig. 1, is set to remove the cake as the section passes over the bridge.

Screen analysis of feed in percentages remaining on screen sizes is as follows: 14, 0.33; 20, 0.82; 28, 2.61; 35, 6.37; 48, 10.95; 65, 13.56; 100, 17.48; 150, 17.33; 200, 13.88; past 200 screen, 16.67 per cent.

The overflow from the drag classifier carries approximately 1.5 tons of fines per 24 hours, and this is caught in an 8x8x8-ft. tank beneath the floor. By regulating the water inflow, the overflow can be reduced to small proportions. Drag pulleys of the submerged type with "cutless bearings" made it possible to reduce the surface agitation in the classifier tank, and under these conditions the overflow fines amounted to approximately 250 to 300 lb. of lead per day, along with small amounts of pyritic concentrate and insoluble. The drag classifier overflow was therefore turned into a waste launder.

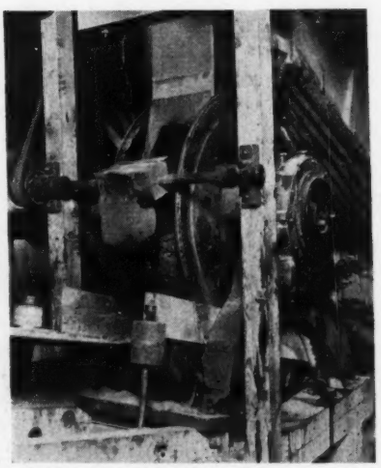


Fig. 3—Feed side of filter, showing "flapper" for compacting cake

When the first experiments were made with the Oliver filter for handling granular concentrate, a metallic cover, of 50 and 60 mesh phosphor bronze, was tried, but it proved ineffective, and Palma twill and dewatering ahead of the filter were substituted. A 24-in. Dorr classifier of standard make was first tried, but proved unsatisfactory on account of the intermittent discharge and the agitation of the water in the box. An Esperanza drag-type classifier was then tried, and with water inflow

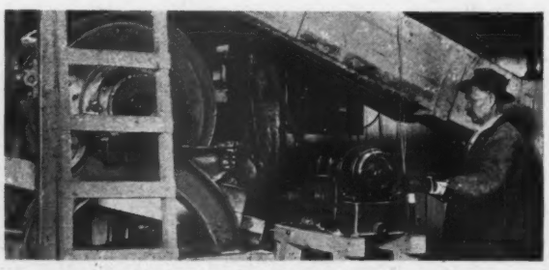


Fig. 2 — General arrangement of filter and drag classifier. Drag classifier is used to dewater concentrates.

controlled and pulleys submerged, satisfactory results were secured.

Previous to the installation of the "top-feed" Oliver filter, table concentrate at the West mill was laundered to settling tanks on the lower mill floor, where is was drained and shoveled into cement buggies and wheeled to the cars. The new installation eliminates settling tanks, labor in handling, and avoids losses of fines from settling tank overflows. It also permits of mixing table and flotation concentrates on the conveyor belt, making a better smelter product.

The unit has operated with comparatively little attention other than periodic inspection by the table operator and the oiler. The "top-feed" Oliver filter is not necessarily applicable to all mill products, but appears to answer for granular materials and flotation products of high metallic content when free from slime.

Manual Operation of Distant Valves Possible Through DeFlorez System of Control

DESIGN of almost all power plants, or processes, involves a system of piping, and indications of the conditions throughout the system are registered or indicated by pressure gages, pyrometers, or various recording instruments. Such types of equipment have been developed to a high degree and their centralization for control purposes has become standard practice, according to R. D. Bean, manager of engineering development for the Brown Instrument Company.

The ideal arrangement of centralized control would be to place in the hands of the operator in charge of the control panel a means of making his own corrections. Many controls are preferably governed by manual operation, and some system of remote manual control, from the board, is necessary to centralize the responsibility for the entire operation under one mind.

Remote valve controls with mechanical connections have been used in the past, but as they are limited in their ability to produce motion at a distance, the control must be effected in many installations by diverting pipe lines to within reach of the control board, or by placing the board in a place favorable to such arrangement. Electrical and hydraulic devices used heretofore have not been particularly well suited for adjustment and have served merely to open or close distant valves.

The ideal control is evidently one in which the receiving mechanism will follow accurately the motion of the transmitter and in which the resistance to motion may be felt on the transmitting end, so that the person in control may be certain that the necessary change is being made and no damage done.

A remote control system, known as the DeFlorez, and using self-synchronizing alternating-current motors which have the property of remaining accurately in phase, is now available for plant operation. When connected and energized, any power applied to one motor will be transmitted to the other with comparatively little distortion. The action of the motors can be used to transmit not only indications but also power necessary to effect control. Evidently, the application of such a principle is wide, and the use of such mechanism will permit greater ease and simplicity in centralized control; and likewise more latitude in designing piping and equipment, inasmuch as the control of certain important valves can be effected without respect to their position in the system.

The motors, known as Selsyn motors, are a product of the General Electric Company and have been used heretofore in connection with fire control on battleships. The diagram below shows the connections for the electric circuit of the transmitting and receiving motors. These are completely incased and are further gas-proofed by suitable covers, the rotating shaft, mounted on ball bearings, being usable in any position. The motors are made in three sizes, depending on the power required and whether the units are required for transmission of power or indicating mechanism.

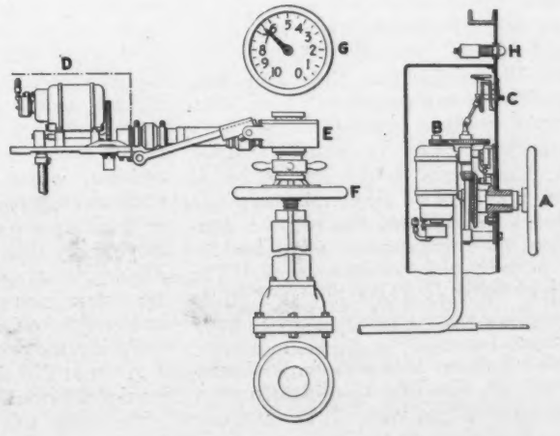
The transmitting mechanism comprises a wheel which rotates a motor through a gearing through which the control is effected. This causes the receiving motor to rotate, its motion being transmitted through a gearing to a shaft and thence to a worm gear which in turn is connected to a wheel on the valve stem. The worm-gear mechanism is connected to the valve wheel by means of a clutch, half of which is clamped permanently to the spokes of the valve wheel, the other half being directly connected with the worm mechanism. A quickly detachable clutch is inserted between the wheel and the worm case, so that the mechanism can be disconnected quickly and at the operator's will.

The drive shaft from the receiving motor is flexible and the mechanism can thus be applied to a wheel solidly mounted on the valve stem so as to rise and fall as the setting is changed. In addition, the worm gear is hollow, so that if the mechanism is applied to a rising stem valve, the stem can pass freely through the center of the worm.

In the type of device here described, the transmitting unit is made up in small panels, roughly 30x16 in. in size, and can be bolted through control panels or assembled in batteries. A pointer or indicator denotes the amount the system is turned and a pilot light indicates whether or not the circuits are energized.

The receiving mechanism can be applied to any type of valve or to effect any rotary motion desired. The power transmitted to it is only that which is impressed on the transmitting wheel. Thus, the resistance to motion can be gaged and the actual amount of correction observed on the wheel in the same manner as it would be observed in turning the valve itself. Some loss in friction takes place, but this is comparatively small, and ample power is provided to start the valve from the full-closed jammed position when necessary.

The motors themselves, which can be likened to rotary solenoids, have a limited amount of torque which they can transmit without having the phase broken down. This torque can be amplified, however, by merely gearing



To control remotely situated valve, turn the wheel A. Wheel motion moves armature of Selsyn transmitting motor B; also moves indicator hand C. At remote control point, Selsyn receiving motor D armature turns synchronously with armature of transmitting motor. Receiving motor armature, operating through suitable linkage and gears, E, operates valve or other mechanism to be controlled. F is distant valve. Dial of indicator G at transmitter shows operator position of distant control setting. H is pilot-light showing that energizing current is on or off.

up the transmitting motor and gearing down the receiving motor. Thus, the power is transmitted at low torque and high speed, and the extent to which the motors are out of phase becomes relatively unimportant, since this amount, which may aggregate 5 or 10 per cent, is reduced in proportion to the gear ratio. If we assume a 10-deg. change in phase of the motor shafts, the transmitting motor and valve wheel would be only $\frac{1}{10}$ degree out of phase, which is practically negligible. The mechanisms are made usually to transmit from 150 to 200 ft.-lb., which appears to be ample to turn any valve mechanism. They also can be made to operate in any ratio desired to obtain close control, and it would be possible to have, by changing the gear ratio, four turns of the transmitting wheel to one turn of the valve in the event a close regulation is desired or a heavy valve is to be turned.

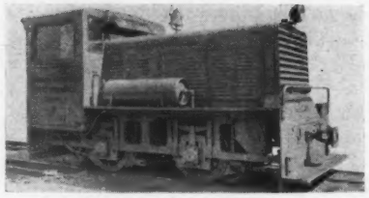
From the point of view of design, the remote control enables considerable saving in piping and may obviate the need of platforms and structural work to operate certain valves. It gives greater liberty in design of the units, as it does not force the position of the control panel in any particular locality but enables it to be placed where least exposed to fire hazard and to dust and dirt. The motors do not rotate when energized by the current; they respond only to hand motion. If the current fails, the valve would remain in whatever setting it happens to be placed; but, as noted previously, it can always be operated by hand and released from the control system if necessary. There is no danger of overloading or of breakage, since the power transmitted is merely that applied to the transmitting wheel. Any resistance on the receiving end is felt on the transmitter, so that, if the valve were jammed or its stuffing box too tight, this resistance would be felt in transmitting the motion.

■

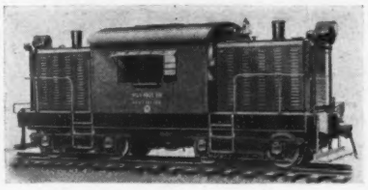
Two Lines of Industrial Locomotives

A new line of gas-electric and oil-electric locomotives in a full range of sizes from 25 to 60 tons has been introduced by the Fate-Root-Heath Company, Plymouth, Ohio. The unit illustrated is a 50-ton gas-electric type. It is 31 ft. 4 in. long and 9 ft. wide. It is equipped with two six-cylinder engines, one in each end, developing 350 hp. at 1,000 r.p.m. The electrical equipment includes two 105-kw. 500-volt d.c. generators (Westinghouse); also four 110-hp. motors, two on each truck. The tractive force is 33,000 lb. at 2 miles an hour and the maximum speed 36 miles per hour.

The Vulcan Iron Works, Wilkes-Barre, Pa., have likewise introduced a new line of gas-electric locomotives,



12-ton narrow-gage gas-electric locomotive



50-ton gas-electric locomotive. Speed varies from 2 miles per hour, with 33,000 lb. tractive force, to 36 miles

ranging from 10 to 40 tons in the four-wheel type and from 20 to 80 tons in the eight-wheel type and in all practicable gages. One of these, a 12-ton narrow-gage locomotive, is shown in a cut. It is powered with a 120-hp. Buda six-cylinder gasoline engine direct-connected to a 250-volt d.c. shunt-wound generator, which furnishes current to two Westinghouse mine-haulage motors geared to the axles. The locomotive has combination throttle and motor control, is compactly built, being only 13 ft. 6 in. long over the bumpers; and is 7 ft. wide and 8 ft. high. Under shop tests it developed a drawbar pull of 8,000 lb. at 3 miles per hour. Its maximum speed is between 18 and 20 miles.

■

Hot Bearings vs. Lubrication

The question of allowable temperatures is one which needs more consideration on the part of manufacturers, according to a well-known maker of filters. Many operators have an idea that if a bearing or electric motor feels relatively warm to the touch, it is overloaded, whereas they never give a second thought to the fact that the crankcase of an automobile engine is so hot that it will blister one's hand, yet there is no more delicate piece of mechanism which runs at an average higher speed than an automobile engine. Electric motor manufacturers rate motors at 40 deg. C., but few operators realize that this means 40 deg. C. above ambient, which under average conditions means approximately 150 deg. F., or a scalding temperature. Neither do they realize that temperatures even over 200 deg. F. are not dangerous, provided the bearings are thoroughly lubricated. In the Fordson manual for tractors the operating temperature of the crankcase is given at 270 deg. F. and 200 deg. F. for the differential.

The same manufacturer's experience with worm gears is that 260 deg. is a perfectly safe temperature, provided all moving parts are at all times flooded with oil, and that the temperature never rises above this point on prolonged operation. During some of his company's experimental work, oil temperatures rose to such a point that solder (used for making an experimental protector for a thermometer inside the oil wells) melted without injuring the gears or breaking down the lubricating qualities of the oil. Naturally, temperatures as high as 300 deg. F. are not recommended, though they are workable.

BULLETINS

Mine Safety Appliances—E. D. Bullard Company, 275 Eighth St., San Francisco, Calif. Catalog No. 30.

Speed Reducers—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Leaflet No. 20472.

Extension Cable Connectors—Crouse-Hinds Company, Syracuse, N. Y. Bulletin No. 2215.

Conveyors — Chain Belt Company, Milwaukee, Wis. Catalog No. 202, bulk material handling conveyors.

Insulation — Rockbestos Products Corporation, New Haven, Conn. Bulletin No. 10. Specifications and applications of insulated wire and cables.

Arc Welding Sets — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Leaflet No. 20390-B.

Electric Heat—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-214A. GE Helicoil sheath-wire immersion heaters.

Pneumatic Tools—Chicago Pneumatic Tool Company, 6 East 44th St., N. Y. City. Bulletin No. 865. Demolition tools and sheeting driver.

Locomotives — Heisler Locomotive Works, Erie, Pa. Catalog on Heisler geared locomotives.

Motors — Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo. Bulletin No. 171, Fynn-Weichsel motors.

Welding—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-881B. General Electric Type WD-200A arc welder continental, gas-engine-driven.

Laboratory Equipment — Denver Equipment Company, 1419 17th St., Denver, Colo. Pamphlet on test work.

Portable Compressors—Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Bulletin No. 83-R.

Water Intake Screens — Link-Belt Company, 910 S. Michigan Ave., Chicago, Ill. Book No. 1252.

Motor Brushes — National Carbon Company, Inc., Carbon Sales Division, Cleveland, Ohio.

Watthour Meters—Sangamo Electric Company, Springfield, Ill. Bulletin No. 79.

Welding—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-569C, which describes constant-potential arc welding sets for any number of operators up to capacity metallic or carbon electrode welding.

Personal Notes

W. B. Gomez has resigned from the staff of Miami Copper, to accept a position as mining engineer with Bagdad Copper, at Hillside, Ariz.

Livingston Wernecke, general superintendent of Treadwell Yukon, at Mayo, Yukon Territory, was recently in San Francisco on his annual visit to headquarters.

H. I. YOUNG

H. I. Young has been elected president of the American Zinc, Lead & Smelting Company, succeeding **W. A. Ogg,** resigned. Mr. Young was formerly vice-president in charge of operations.

Andrew M. Fairlie, consulting chemical engineer, of Atlanta, Ga., returned to New York on June 16 from a business trip to England, France, Belgium, and Germany.

Walter A. RuKeyser sailed from New York on June 17 for Russia, where he will act as consultant to the U.S.S.R. state trust, Uralasbest, in the design and erection of asbestos plants.

G. H. Cunningham, who recently completed electrolytic zinc investigations for American Smelting & Refining, has joined the staff of San Francisco Mines of Mexico, at Laredo, Tex.

Charles E. Locke, professor of mining and ore dressing at the Massachusetts Institute of Technology, has been appointed secretary of the alumni association of the Institute for 1930-1931.

H. K. Najarian returned to New York on June 10 from a three months' trip to Chile and Argentina. His address will be care of St. Joseph Lead Company, 250 Park Ave., New York.

Dr. **Bradford Willard** has resigned his position as assistant professor of geology at Brown University, to become associate geologist with the Topographic and Geological Survey of Pennsylvania.

Irving M. Symonds, who has been for several years on the metallurgical staff of Inspiration Consolidated in Arizona, has accepted a position with the Compañia Minera de Peñoles, at Mapimi, Durango, Mexico.

Dr. **A. C. Lawson,** professor of mineralogy and geology at the University of California, is in Europe, arranging the program of the 1932 International Geological Congress. Dr. Lawson is chairman of the program committee of the congress.

C. M. Eye, mining engineer, of San Francisco, has returned after three months at the Benguet Consolidated Mining Company's property in the Philippine Islands. Mr. Eye is the representative of the company in the United States.

Ludwig Vogelstein, chairman, and **Heath Steele,** vice-president, of American Metal, sailed from New York on the "Europa" on July 5. After a short stay in London, Mr. Steele will visit his company's interests in Rhodesia, returning to New York some time in November.

Scott Turner, director of the U. S. Bureau of Mines, has been appointed to represent the A.I.M.E. at the annual meeting of the Institution of Mining Engineers, to be held at Birmingham, England, early in July. He sailed from New York on the "Bremen" on June 27.

W. Ray Cox, after eighteen years of government employment, has resigned his position as mining engineer in the Field Service of the U. S. General Land Office, and has opened his own office as consulting mining engineer in Portland, Ore. Previously he was a mining engineer with an office at Goldfield, Nev.

Dr. **Franklin P. Lasseter,** of Ohio State and Columbia universities, has been appointed to a fellowship at the Mellon Institute of Industrial Research, in Pittsburgh. Doctor Lasseter will investigate the basic principles involved in problems of the field of The Dorr Company, which is sponsoring and supporting the fellowship.

Erle V. Daveler, who was recently elected treasurer of Utah Copper, has also been appointed to the post of assistant general manager of the company. **J. D. Shilling,** formerly mine superintendent, has been promoted to the newly created position of assistant to the general manager, and **Louis Buchman,** assistant mine superintendent, has been made mine superintendent. Mr. Daveler's headquarters will continue to be in New York.

OBITUARY

Fred Asa Hall, prominent in mining circles in Canada, and a founder and former president of the Toronto Standard Stock and Mining Exchange, died at his home in Toronto on June 17, after a brief illness. Mr. Hall was 73 years of age.

George W. Hain, general manager of the Detroit plant of the International Salt Company, died at his home in Dearborn, Mich., on June 13, at the age of 45. Mr. Hain had been with the Detroit Rock Salt Company for more than twelve years. He graduated from Lehigh University with the degree of mining engineer.

David R. C. Brown, pioneer in the development of the Aspen district of Colorado, died at Aspen on June 29. He was 73 years old and first went to Aspen in 1881, although he had been in Colorado since about 1870. He was a native of New Brunswick, Canada. Mr. Brown, who had been ill for almost a year, is survived by his wife and six children.

J. E. Brett, mining enginer and geologist, of Toronto, drowned on June 19, near Martin Falls, Ont., as a result of the capsizing of a plane in which he was prospecting at the time. The plane landed in rough water on the Albany River. Mr. Brett was 37 years old and had been connected with the development of several Ontario metal mines, including the Brett-Tretheway silver property, which was named for him.

Col. **William Boyce Thompson** died at Yonkers, N. Y., on June 27 at the age of 61. Colonel Thompson contracted pneumonia about a week before his death, although he had been an invalid since 1926. Throughout his long illness, however, he had maintained his active interest in mining affairs. Colonel Thompson was born in Virginia City, Mont., and was the son of William Thompson, who had extensive holdings in the Butte district. After receiving his preparatory training at Phillips Exeter Academy he attended Columbia University, where he took the mining engineering course. After practising his profession in Montana for several years, Colonel Thompson met D. C. Jackling, and became affiliated with him in several of his ventures, notably the Utah Copper project. Subsequently he was connected with development of the Nevada

W. B. THOMPSON

Consolidated, Inspiration, Mason Valley, Magma, and Flin Flon ventures.

He was the backer of Texas Gulf Sulphur, which was the first and still is the most important company using the hot-water-pumping method of recovering sulphur. Newmont Mining, possibly the best known of the holding companies in the mining field, was one of Colonel Thompson's projects, and he was still chairman of it at the time of his death. He was widely known as a philanthropist, and for some time was chairman of the ways and means committee of the Republican party. He was a director of the Federal Reserve Bank of New York from its founding in 1914 until 1919. His title of "Colonel" was obtained from his commission as a lieutenant-colonel in the U. S. Army in 1917. Colonel Thompson founded the Boyce Thompson Institute for Plant Research, and bequeathed to the American Museum of Natural History his famous collection of minerals.

NEWS OF THE INDUSTRY

Several Sudbury Mines Closed by Floods

Treadwell Yukon closed its Errington mine for five days from June 27 to July 1 as a result of floods in the Sudbury district of Ontario. The Falconbridge Nickel mine was also closed down on the same date, while the Creighton mine of International Nickel was placed on a reduced production basis. The shutdowns were caused by flooding of power plants. At the Errington and Falconbridge mines, power was cut off as a result of the flooding of the No. 2 plant of the Hydro-Electric Commission on the Wahnapitae River. At the Creighton, reduced operations were necessitated by the closing down of one of the units at the High Falls power plant, owing to a jam of logs on the Spanish River. Other small operations in the Sudbury district as well as in the Cobalt areas were also affected. Except for the loss of production, no damage is reported by the larger mines.

Crosscutting has been started north from No. 2 shaft at the 1,500 level of the Errington mine to develop the downward extension of the orebodies. More than 100,000 sq.ft. of ore has been exposed in development faces and stopes at the 500 level. By November sufficient information should be available for directors to make a decision regarding enlarged metallurgical facilities at Sudbury. Some time ago F. W. Bradley, president of Treadwell Yukon, stated that if developments at 1,500 ft. proved as encouraging as those at 500 ft., plans would be prepared for a 2,000-ton smelting and refining plant. The present 300-ton test mill is operating steadily, and regular shipments of copper, lead, and zinc concentrates are being made. A fourth product, iron pyrites, is being stored for shipment in August.

■

Coppermine Area Now Open for Staking Minerals

Effective July 1, 1930, the Coppermine River area, west of Coronation Gulf on the most northerly tidewater of the North American continent, was thrown open for staking for minerals by the Dominion of Canada. The area lies well within the Arctic Circle and embraces a large part of the Arctic coast and islands to the north. According to tradition native copper was found by the Hudson Bay Company explorer, Samuel Hearne. Numerous stories have been handed down regarding the use of native copper by the Eskimos in the manufacture of utensils.

During the last two years, active investigation of the Coppermine area along with Great Bear Lake and surrounding territory has been carried out by Dominion Explorers and Northern Aerial Minerals Exploration. On July 1 both companies had prospectors on the ground ready to secure the best locations. Details of discoveries have been somewhat guarded, but, from the extensive preparations to secure ground, results are believed to have been interesting. An official report by the Department of the Interior at Ottawa stated: "There is considerable promise that in the vast area of the 'height of land' country, which includes the western border of the Canadian shield, major mineral deposits will be found."

In addition to its activity in the Coppermine area, Dominion Explorers is investigating a discovery of copper in sulphides at Hunter Bay and Great Bear Lake. Parties bound for the scene of the new activity may go by airplane or overland by rail to Waterways, Alberta, thence by boat down the Athabasca River, across Great Slave Lake, and down the Mackenzie. According to Hudson Bay Company reports, the investigators will find Great Bear Lake still partially ice-bound. Planes flying to those regions are equipped with skis as well as pontoons.

■

New High-Grade Ore Found on Surface at Flin Flon

Official announcement has been made that in cleaning out the bottom of Flin Flon Lake, in northern Manitoba, Hudson Bay Mining & Smelting has found a high-grade copper orebody on the surface. The ore is said to compare with the high-grade shipped from the upper workings of the neighboring Mandy mine during the World War. The size of the new deposit has not yet been determined, but exploration has been started. Ore from this source will be treated in the plants now under construction as soon as possible and should materially improve the average grade handled. Gold content is said to be high. Power is now being used at Flin Flon from the company's 44,000-hp. Island Falls development, in Saskatchewan.

In regard to the progress on the plant, the zinc stack has been completed and the hoist houses are in place. Work is well advanced on the crushing plant and concentrator, which should be completed by the end of July. The cyanide annex is being installed and is 70 per cent completed. The change house has been erected and the finishing touches are being put on the zinc casting plant.

About 100 additional men have been put to work on construction of the 1,800-ton copper concentrator that Sherritt Gordon Mines is building at Cold Lake and that will be one of the principal shippers to the Flin Flon smelter. Operation is expected to start by the time the smelter is ready.

The building to house the main crushing plant, which will be on the surface, is now completed. The concentrator mill building will be 175x160 ft. Foundation work for this is well under way. At the main shaft the steel headframe is completed and inclosed and two double-drum hoists are being installed. A hollow tile steel frame addition to the power house is completed and two vertical compressors are being installed.

Tintic Only Utah District to Report Higher Shipments

Shipments for the first six months of 1930 from the several Utah mining districts to Salt Lake Valley smelters have just been made public. The Tintic district is the only one of the three larger camps to show a gain over the corresponding period of 1929, and there the increase resulted largely from greater activity in mines carrying predominantly gold ores and from shipments of dump material.

During the last six months, the Tintic mines shipped 3,352 carloads of ore, carrying lead, silver, and gold, with some copper and zinc. In 1929, shipments were 2,899 carloads. Eureka Lilly, subsidiary of Chief Consolidated, reported a large increase in output. Tintic Standard shipped 1,023 carloads, compared with 1,090 last year; and North Lily shipped 545, compared with 509.

Park City shipped 113,030 tons of ore and concentrate in the period under review, compared with 171,339 tons in the first half of 1929. Lead, zinc, and silver are the chief constituents of Park City ore. Park Utah shipped 78,946 tons, compared with 113,821 tons in 1929; Silver King shipped 24,426 tons, nearly all concentrate, compared with 28,189 tons. New Quincy also decreased its output, but Park Galena and Park City Consolidated, which are still largely in the development stage, showed relatively large increases.

At Bingham, most properties shipped considerably less. The camp produces copper, lead, zinc, gold, and silver in important quantities. Utah Copper, which last year was shipping about 60,000 tons daily, is now shipping about 35,000 tons. Utah Apex, Utah Delaware, Utah Metal & Tunnel, and Bingham Prospect reported smaller shipments, but the United States mine, including the property formerly held by Bingham Mines, shipped a larger tonnage and Ohio Copper produced about as much as in 1929.

Horn Silver, in Beaver County, increased its shipments from 180 carloads for all 1929 to 278 carloads for the first six months of 1930. Output from other outlying districts was small. American Smelting & Refining has just started shipping from the Yankee Mines property in American Fork Canyon, and production from that district will probably show an increase in the second half of the year.

■

American Zinc Drills in Missouri

American Zinc, Lead & Smelting is drilling on the Wampler tract, northeast of Carthage, in the Tri-State district of Missouri. The company has obtained lease rights in that vicinity, and will move its head offices from Boston to St. Louis, as a result of the recent election of H. I. Young as president.

Bonne Terre unit of St. Joseph Lead, in southeast Missouri

Drop in Silver Price Closes Presidio Mine, in Texas

Operations at the Presidio silver mine, at Shafter, Tex., were completely suspended on July 1 as a result of the continued decline in the price of silver. American Metal, which acquired the property in the early part of 1928, had been producing about 1,000,000 oz. of silver annually, in addition to some lead and gold. The mine is equipped with a 200-ton mill, from which concentrate was shipped to El Paso and cyanide precipitate to Selby, Calif. Presidio had been in operation for more than forty years. General H. W. Shafter was one of the original operators of the mine.

■

Pioche Railroad Only Leased

In the issue of June 23, statement was made that Bristol Silver Mines had purchased the Pioche Pacific Railroad, operating a 15-mile narrow-gage line between Pioche and Jackrabbit, Nev. W. J. Palmer, president of the railroad company, advises us that the Pioche Pacific Railroad leased that part of its property that runs from Pioche to Jackrabbit and that it is still operating, on its own account, what is known as the Hill division.

■

Ohio Continues Tailing Tests

Within thirty days, Ohio Copper hopes to have completed details of the flow sheet for its new tailing re-treatment plant. Tests are now being made on the dump at Lark, in the Bingham Canyon district, Utah. In the mine, the company is prospecting the limestone formation on the 700 level, below the Mascotte tunnel, by drifting and diamond drilling.

■

Pacific Coast Men Talk Mining

On July 7, a meeting was held at Weaverville, Calif., in which the northern chapter of the Mining Association of California, Southern Oregon Development Association, and the California Chamber of Commerce participated.

Six Indicted on Charges of Fraud in Butte Promotion

Six men, including Magistrate George F. Ewald, of New York City, were indicted by a federal grand jury on July 7 of using the mails to defraud and conspiracy to use the mails for that purpose in connection with the promotion of the sale of stock of Cotter Butte Mines, a property in the Butte district of Montana. A total of 800,000 shares of treasury stock is alleged to have been sold for prices ranging as high as $1.50, but only 25c. per share is said to have been allocated to the company. Estimates of the losses to investors are put at about $400,000. According to United States District Attorney Tuttle, the only important development work on the property is a tunnel that was in existence before the present promotion started. Reports published by the company that a high-grade copper-silver-gold vein had been struck in its holdings are described by government officials as entirely false.

■

Venezuela Gold Mill Starts

Operation of the first unit of the new 350-ton mill of New Gold Fields of Venezuela, in the Roscio district, State of Bolivar, Venezuela, was started in May. The company had been treating about 50 long tons daily in a pilot plant and produced, in 1929, a total of 11,700 oz. of gold. Grade of ore is about 9.7 dwt. of gold per long ton. Capital of the company has been increased by the issuing of 700,000 new shares of 5s. par to take over the property of Bolivar Venezuela Gold Mines, adjoining the New Gold Fields concession on the east.

■

Cloncurry Builds Leaching Plant

Cloncurry Copper, Ltd., has been formed in Brisbane with a capital of £20,000 in 5s. shares to operate the Vulcan property, 28 miles from Cloncurry, Queensland. The known orebody is 450 ft. long and 100 ft. wide and is said to be ideal for open-pit mining methods. A leaching plant will be built to use the so-called Murdoch process. About 100 tons of 5 per cent copper will be treated daily.

Germany Puts Heavy Duty on Aluminum Imports

Berlin, Germany, July 5.—A duty of 250 marks per metric ton on unmanufactured aluminum imported has just been ratified by the German legislature. This step has been taken because of fears that the Aluminum Company of America might possibly dump its surplus aluminum on the German market. As the Aluminum Company of America has shown no inclination to join the European cartel, the members of that organization unanimously approve of the German move.

At a meeting of zinc producers, American Smelting & Refining is reported to have urged restriction of all European output to the extent of nearly 25 per cent, instead of the prevailing rate of 10 per cent. The company states that it is willing to cut its own exports by that amount. German producers remain unwilling to join in this restriction, however, as they still have hopes of a tariff that will permit Germany to become self-sufficient.

Not much hope is entertained here for the success of the proposed Mexican conference on silver. Any attempt to stabilize the price would create an enormous valorization, local experts feel, and the burden would be staggering. Mansfeld and Stolberg, the two largest domestic silver producers, are having great difficulty disposing of their stocks of the metal.

■

Geophysicists Will Meet in Stockholm Next Month

Announcement has been made of the provisional program for the fourth general meeting of the International Union for Geodesy and Geophysics in Stockholm, Aug. 15-23, this year. The main part of the program will be devoted to scientific papers on geodesy, meteorology, oceanography, and vulcanology. In connection with the congress there has been organized an exhibition of geophysical instruments and maps, showing practical results of geophysical work in different parts of the world. During the week of Aug. 24-30 excursions will be made to different parts of Sweden, such as the iron mines in Lapland and the copper field at Boliden, recently discovered by geophysical methods. Axel Wallén, Stockholm 8, is general secretary of the Swedish organization committee.

■

File W. B. Thompson's Will

The will of the late Col. William Boyce Thompson, mining engineer and financier, who died June 27, disposing of an estate estimated at more than $85,000,000, has been filed for probate. Principal legatees are the widow, Mrs. Gertrude H. Thompson, and her daughter, Mrs. Margaret Schulze. Estimates of the estate have ranged as high as $125,000,000. Colonel Thompson's vast collection of minerals, carved stones, and curios is left to the American Museum of Natural History, with one proviso, however, that it be given by written consent of his family or remain in the family until after death of the widow and daughter.

Curtail at Nevada Con.

Nevada Consolidated Copper has discharged 200 men at its properties in the Ely district of Nevada. Only one reverberatory furnace is now being operated in the smelter at McGill. The concentrator is treating 10,000 tons of ore daily, of which 3,000 tons comes from Consolidated Coppermines. Capacity is 18,000 tons.

■

Reduce United Verde Force

Because of the poor copper market, United Verde Copper has been forced to lay off 800 men at its properties in the Jerome district of Arizona, or more than one-third of the entire working force. Further reductions in output will result. The company has been endeavoring to maintain employment by increasing development and construction work.

■

Mountain Copper Curtailing

Mountain Copper Company, of Shasta County, Calif., which has been operating its No. 8 mine for almost a year, has started curtailment at this mine. However, the company is expected to resume work at the Hornet mine, from which shipments of pyrite will be made. Operations at its cyanide plant, where 300 tons of gossan ore per day is being treated, are being continued.

■

Mayflower Suspends All Work

Suspension of work at Mayflower-Old Colony, which has been endeavoring to find a copper-bearing orebody in its lands, has been caused by market conditions which discouraged payment of assessments. The property has been one of the most extensively explored in the Michigan district, several millions of dollars having been expended in the last 30 years in the search for a profitable vein. Badly folded ground in the shaft area led to driving a crosscut west from the 1,750, or bottom, level, the longest crosscut in the district. Several veins with good characteristics were cut, but none yielded ore in drifting.

■

Map Program for U. of Utah

The advisory board to the department of mining and metallurgical research of the University of Utah, in cooperation with the intermountain station of the U. S. Bureau of Mines, and the affiliated technical subcommittees, held its annual meeting on June 26 at the University of Utah to discuss and prepare the program for the coming year. Members of the advisory board for the ensuing year are L. S. Cates, president, Phelps Dodge, chairman; J. O. Elton, manager, International Smelting, vice-chairman; G. W. Lambourne, president, Park Utah Consolidated; E. J. Raddatz, president, Tintic Standard; W. J. O'Connor, manager, Utah department, A. S. & R.; W. Mont Ferry, managing director, Silver King Coalition Mines and president, American Silver Producers Association; W. H. Eardley, assistant manager, U. S. S. R. & M.; and Dr. Dorsey A. Lyon, administrative head.

Thirty tons of native copper were contained in this mass, struck on the No. 86 level of the Quincy mine, near Hancock, Mich.

Quincy Output Rising as Mine Is Put in Condition for Stoping Operations

PRODUCTION from the property of Quincy Mining, near Hancock, in the Michigan copper district, is now about 1,500 tons of ore daily and is continuing to increase as preparations are made for stoping. Almost three years have now elapsed since the fire in No. 2 shaft and subsequent "air blasts" necessitated a complete program of rehabilitation for the property. Production of copper in 1926, the last normal year, was 6,645 tons; in 1927, 4,859 tons; in 1928, 610 tons; and in 1929, 2,230 tons. The average yield of ore now being sent to the mill is almost 26 lb. of copper per ton, which would indicate an annual output of about 6,000 tons of copper. The average yield of Quincy ore in the decade 1910-1920, when dividends were last paid, was about 15 or 16 lb. of copper per ton.

More than 9 miles of new openings have been driven at Quincy, and ore reserves are now said to be sufficient to insure profitable operation of the company's remodeled mill. More than half the present output is coming from drifts and the remainder comes from raises and other development work necessary in opening up stopes. Quincy has seven levels developed in Nos. 2 and 6 shafts in which no stoping has yet been done, and every drift in the mine is reported to be in ore.

Use of flotation in the Quincy No. 1 stamp mill has reduced the loss of copper in tailing from about 5 or 6 lb. to about 2 lb. The roughing and finishing jigs now in use will be replaced with roughing tables, and an even greater saving is expected. When all improvements contemplated have been finished, the plant will have a capacity of 4,000 tons of ore daily. No. 2 mill, which will be used exclusively for re-treatment of old tailing, will be similarly equipped, and its capactiy will closely approach that of the No. 1 plant. The two plants formerly had a combined capacity of 5,500 tons daily.

The accompanying photograph shows the large copper mass that has just been completely removed from the No. 86 level north drift, near No. 8 shaft. This mass, one of the largest ever mined in Quincy, was about 30 tons in weight, 25 ft. long, 8 ft. wide, and 3 ft. thick. It was cut with Ingersoll-Rand pneumatic chisels and removed in blocks weighing about six tons each. The mass was cut in drifting on the main vein, at a depth of about a mile. When this photograph was taken, about 6 tons had been removed.

■

Ajo Leaching Plant Closed, But Mill Continues

Calumet & Arizona has suspended operations at the leaching and electrolytic plants of its New Cornelia unit, Ajo, Ariz., because of the depressed condition of the copper market. The leaching plant, which can handle about 5,000 tons of 1.1 per cent ore daily, was the original producing unit at New Cornelia, but with the development of large tonnages of sulphide ore and the gradual exhaustion of the carbonate ore, the flotation plant has gradually taken its place. In 1929, less than a third of the total New Cornelia production came from the leaching plant and the company has probably decided, therefore, that operation of the concentrator only at this time would be a more economical procedure.

Closing of the leaching plant will not mean a cut in output from Ajo, as the flotation plant has a large excess capacity, but it will lower costs. Calumet & Arizona is now producing 7,500.000 lb. of copper monthly from its several mines, whereas capacity is at least 15,-000,000 lb. a month. No further cuts in production will be made, but increases will depend entirely on market conditions.

Senate Committee to Study Effects of Low Silver

An investigation of commercial relations between the United States and silver-using countries—notably, China, India, Mexico, and the South American republics—will be undertaken by a subcommittee of the Senate Committee on Foreign Relations immediately after the special session called by President Hoover for ratification of the naval treaty. The investigation has been authorized by a Senate resolution offered by Senator Pittman, chairman of the subcommittee, which will seek to determine whether, by international agreement, treaty, or otherwise, the price of silver and the buying power of the countries using silver as a medium of exchange can be raised. The other members of the subcommittee are Senators Johnson, of California; Vandenberg, of Michigan; Shipstead, of Minnesota; and Swanson, of Virginia. The committee's findings will be presented to the Senate in the form of a resolution suggesting what action President Hoover should take with the object of stabilizing the price of silver.

In view of the prospective investigation by Senator Pittman's committee, Senator King has tabled his resolution proposing that President Hoover approach other silver-producing countries on the question of calling an international conference to consider means of stabilization.

The Commerce Department's silver research program, suggested by Senator Oddie, has not yet taken definite form. In response to Secretary Lamont's request, the Bureau of Standards has submitted an outline of the directions in which technical research offers some promise for providing a greater outlet for silver in industry, but to date the U. S. Bureau of Mines and the Bureau of Foreign and Domestic Commerce have not formally submitted their recommendations.

There is some question whether sufficient funds are available to undertake the extensive investigation along technical and economic lines that is urged by Senator Oddie. He has suggested that the department might well spend $100,000 for this purpose. The regular fiscal appropriations of the several bureaus are earmarked for specific projects long before the funds are actually in hand. There may be an opportunity to shift allotments made for their work during the new fiscal year, which commenced July 1, but this has not yet been determined.

The Commerce Department cannot engage in any program beyond its immediate resources, as executive agencies of the government are prohibited by law from incurring a deficit in anticipation of an appropriation by Congress at a later date. If it develops that the department is not in a position to finance a research program sufficiently broad to meet the emergency, the only alternative is to wait upon an appropriation by Congress next December. It is understood that, if necessary, Secretary Lamont will recommend this item for inclusion in the first deficiency appropriation bill to be brought before the next Congress. Senator Oddie also is prepared to urge appropriation of any additional funds that may be needed to carry out the program.

Special consideration for the present condition of the silver industry and its need for more extended markets was urged by the American Mining Congress in a letter addressed to Secretary Lamont by J. F. Callbreath, the secretary, on June 27. "Aside from the silver producer," said Mr. Callbreath, "I feel that we have a broader interest because of the fact that the present low prices of silver have reduced by more than half the visible wealth of more than half the peoples of the world. The vast populations of India and China should be developed into great consuming areas for the surplus manufactured goods of this country, but the present depreciation of silver, in which their visible wealth is mostly contained, cannot but hamper greatly their ability to buy goods of American manufacture."

■

Commerce Starts Bird Dog, Newest Mill in Tri-State

Operation of the new Bird Dog mill of Commerce Mining & Royalty was started in the last half of June. The plant is west of Commerce, Okla., and will handle ores from ten or twelve restricted Indian allotments. It is of all-steel construction and is of the same modern design as the company's new Paxson plant. Each of these plants can handle 100 tons of ore an hour, or 2,400 tons daily when run on three shifts. They are designed to cut costs of production, which, with present low prices for concentrate, threaten to close most of the smaller plants.

Among Tri-State mills closed during the week ended June 28—when the price of zinc concentrate averaged $28 a ton—were the Mary M., Ramage, Tri-State Zinc (White), and two of the Admiralty Zinc plants.

■

Congressional Taxation Body to Consider Depletion Rate

With a view to recommending appropriate amendments to the revenue laws, the Joint Congressional Committee on Internal Revenue Taxation will hold a hearing early next December on the problem of computing depletion in ore reserves for tax purposes. Representative Hawley, of Oregon, chairman of the Joint Committee, has tentatively suggested Dec. 9 as the date for the hearing. The committee's staff submitted a report last fall recommending that depletion should be expressed in terms of percentage of net income. No action will be taken on this report until the committee has heard the representatives of the mining industry.

Although Congress will probably not consider any general revenue legislation in the short session, representatives of the mining industry who are co-operating with the joint committee are hopeful that, if they act promptly in presenting their views to the committee, Congress will enact legislation amending the administrative sections of the revenue laws for the purpose of placing accounting for depletion of mines on a more equitable basis.

■

Build Barite Mill at Barstow

A 100-ton mill for the flotation treatment of tailing containing barite has been constructed at Barstow, Calif., by B. S. Hook and C. Shapley, according to local report. Tailing from the old Waterman mine, near Barstow, will be handled and the product shipped to Los Angeles.

Utah Lead Promoters Are Sentenced to Prison

On June 26, Judge John C. Knox, of New York, sentenced Charles Beadon, Michael Barnett, and Harry Phillips, who were connected with the stock-market promotion of Utah Lead, to sentences varying from one year to five years in the federal penitentiary. W. H. Rankin was placed on probation for five years, and *Stock Market Reporter* and *Trend of the Market*, two publications backed by Beadon, were fined $16,000 each.

The defendants were found guilty of using the mails with intent to defraud. A previous trial had ended in mistrial because of the alleged attempt of the defendants' lawyers to bribe one of the members of the jury. Since then the lawyers have also been sentenced to prison. *Engineering and Mining Journal* commented editorially on the Utah Lead promotion in its issue of Aug. 11, 1928. The Better Business Bureau of New York City, 280 Broadway, has published a bulletin giving details of Beadon's career and the trial.

■

United Gold Plans Long Drifts at Cripple Creek Mines

United Gold Mines, of Cripple Creek, Colo., has undertaken an extensive plan of new development work on its various properties. A drift, 1,200 ft. long, will be started from the Rose Nicol claim to the Coriolanus claim. It will be entirely in virgin territory except for some shallow surface work and will go through the Trail and the Big Banta claims, as well as the Rose Nicol. Its purpose is to explore the Silver Dike, parallel to the Funeral Dike, which has carried most of the Cresson Consolidated ore.

Another drift that United Gold Mines is planning will be driven from the Vindicator over to the old Victor mine, the company having acquired the Maud Helena property situated between them.

■

Money Metals Drifting Along Dike in Big Bug Area

Drifting in a porphyry dike on its property in the Big Bug district, 18 miles south of Prescott, Ariz., is being continued by Money Metals Exploration. The company holds seven claims, 1½ miles west of the railroad terminal at Poland, on which the main development has been conducted through a 300-ft. incline shaft. The mineralization, which carries gold, silver, lead, and copper, occurs in lenses along the contact of the country granite with the porphyry dike.

On the 200 level, two lenses have been opened up in drifting 600 ft. on a well-defined fissure in the porphyry dike. Drifting on the fissure at the 300 level has struck one of the lenses and is now close to the point where the second should be cut. A drift has also been driven for 125 ft. along a second fissure at this depth in the hope of encountering a third lense. Drifting on the 300 level will be continued to the boundry of the property, a distance of 3,000 ft., with occasional crosscuts to both contacts. The shaft will also be sunk to 600 ft. and development done at that depth.

Ennis Estimates Big Savings With New McIntyre Mill

Construction of its new 2,000-ton flotation plant will make possible savings of from 40 to 50c. per ton of ore treated, according to R. J. Ennis, general manager of McIntyre Porcupine Mines, which is planning to build the plant immediately at its mines near Porcupine, Ont. At the annual meeting of shareholders in Toronto on June 25, Mr. Ennis stated that the saving in operating costs through the elimination of fine grinding and other factors in mill operation would be about 28 to 30c. a ton. In addition, construction of the plant at the No. 11 shaft headframe would eliminate expensive tramming that is now necessary because of the fact that the present mill is on the opposite side of Pearl Lake from the shaft.

Cost of the new flotation plant will be $1,300,000. A saving of 50c. a ton, or $1,000 a day, will amortize this cost in four years. Ratio of concentration will be about 7:1, meaning that only 13 per cent of the tonnage treated will have to be cyanided. The plant will occupy only 48 per cent of the space required by a plant of similar tonnage using the old flow sheet.

Mine developments in April, May, and June have been very good, Mr. Ennis stated in covering progress since the preparation of the annual report. About 56 per cent of development work has been in ore. The company's geologist's have been studying the north and south shear zones, which have not been productive of ore as yet, and they have come to the conclusion that ore may be found between the 3,000 and 4,000 levels. Within the next year the company will investigate these possibilities.

■

Premier Gold Resumes Work at Silverado

Premier Gold has resumed exploration work on the Silverado group, near Stewart, B. C. Work was suspended last January, but a watchman was retained on the property. Premier acquired control of the property in 1928 and started a tunnel to open a shear zone, in which four promising silver-gold veins had been exposed at the surface, at a depth of 600 ft. Because of the sheerness of the mountain this seemed the only way that the property could be satisfactorily developed. The tunnel was driven 1,048 ft. and some drifting was done on what, by survey, was supposed to be the downward extension of No. 1 vein, the richest of the four exposed at the surface. A raise was started and drifts were opened at intervals, but no ore was found until the raise was within 145 ft. of the surface, where samples from a 2-ft. vein averaged 0.05 oz. in gold and 35.5 oz. in silver per ton, 6 per cent lead, and 7.3 per cent zinc. Exploration will be continued from this point.

■

Canadian Mines Survey Has 58 Field Parties

The Geological Survey of the Canadian Department of Mines will have 58 parties in the field this year. Forty will be engaged in geological work—mapping, investigation of mineral deposits, water supply and other economic features, and scientific investigations. Thirteen will make topographical surveys. Three will investigate geophysical methods of prospecting and two will collect specimens for the National Museum. These parties will be distributed over most of Canada. The most northerly one will be near Chesterfield Inlet, on Hudson Bay, in latitude 63 deg.; the most westerly one will be in Yukon, and the most easterly at Sydney, N. S.

About 240 persons in all will be employed. Of these, 46 are permanent survey officers in charge of parties. Eleven other parties will be in charge of university teachers or specialists from other institutions, who are employed during the field season. These heads of parties will be assisted by 115 university students in geology and engineering. Ten student assistants have been assigned investigations that will be the subjects for their doctorate thesis studies at universities in Canada, the United States, and England. The remainder, about 70 in number, comprise cooks, packers, canoe men, and other field help, mostly whites but including a few Indians and Eskimos.

Australian Mines Affected by Low Metal Prices

The fall in the price of base metals has affected the mining industry throughout Australia, although most of the large companies will continue production. At Broken Hill, Block 14 is preparing to close its mine. The company has abandoned its option on the Tasman & Crown Lyell Extended mine, in Tasmania, because the tonnage developed, although of good grade, was very small. The North Mount Farrel flotation plant at Tullah, 10 miles north of Roseberry, Tasmania, has been closed indefinitely because of low prices of lead and zinc. Some high-grade ore is being mined and jigged to a marketable grade, however. In Queensland, most of the mines in the Herberton and Chillagoe districts have had to close. The government-operated Chillagoe smelter has made a reduction in its smelting rates in aid of the industry.

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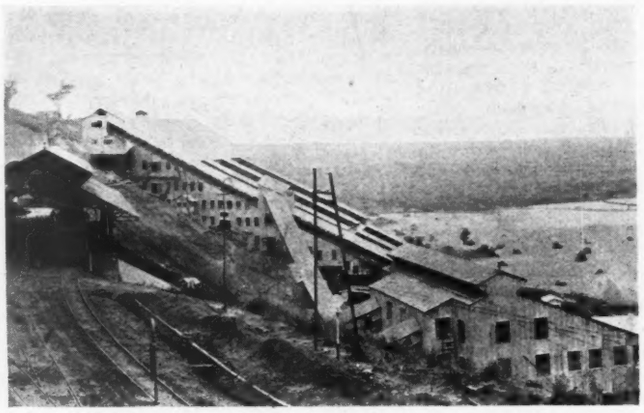


Union Minière's flotation plant, which treats 4,000 tons of copper ore daily at Panda, Belgian Congo

■ ■ ■

B. C. Prospectors Are Active Despite Low Metal Prices

With the exception of the large mining companies—Consolidated, Britannia, Granby, Premier, and Base Metals — only Planet Mining, Hecla's Union property, and a group of small, rich silver mines on Wallace Mountain are producing regularly among British Columbia metal mines. Prospecting is more active than ever, as the closing of so many small mines has released large numbers of men who, rather than be idle, have taken to the hills in search of new mineral deposits. The little-known northwestern section seems to be the region most favored by prospectors.

Consolidated is operating its Sullivan mill at capacity, but is storing a considerable proportion of the zinc concentrate, as until more power is available it cannot be treated at the smelter. At a recent meeting of the Associated Boards of Trade of Eastern British Columbia at Kimberley, when the delegates were the guests of the Consolidated company, T. W. Bingay, vice-president in charge of finances for Consolidated, reiterated the statement that has been made by other officers of the company, that Consolidated will continue to operate as long as any lead-zinc concern, as it is able to produce those metals more cheaply than any of its competitors.

The company has sent out a large number of prospecting parties to different parts of this province and adjoining provinces and territories, and during the season it will do a large amount of reconnaissance surveying from hydroplanes. With this in view it is establishing a base at Burns Lake, on the Canadian National Railway, where it is sending a seven-passenger plane. The country around will be mapped to show suitable places for the alighting of hydroplanes and promising bases for the headquarters of exploration parties. Gasoline caches are being established along the northern rivers for refueling planes. Besides this new work, the company is continuing the exploration started during the last three years at some twenty different and widely separated parts of British Columbia.

■

Wash Cut in Otago Area

Underground exploration by Cornish Point Gold Mines, in the Kawarau alluvial gold area, part of the Otago district, South Island, New Zealand, has struck a heavy body of alluvial wash, identical in many respects with that dredged in adjoining areas. The gold is "rusty" or "black" in appearance, such as is found only on the Lady Ranfurly and Gee's Flat mines within this area. Work on the deep lead is proceeding steadily.

Dos Estrella Drops Option on El Oro Tailing

In view of economic conditions and results obtained by experiments, both in the United States and at the mine, on tailing from the Mexico Mines of El Oro dump, in the El Oro district, Mexico, Compañia Minera "Las Dos Estrellas" has decided to give up its option on the dump. The company had been considering construction of a flotation plant to treat the dump, which is estimated to contain about 1,200,000 tons, averaging $3 a ton in gold, as well as additional material of lower grade. However, the management decided that the proposition is not sufficiently attractive at present to warrant the investment of the capital required for the construction of a mill.

■

Would Drop Mexican Duties on Mining Equipment

One of the most important steps in the efforts to find a solution for Mexico's mining crisis, particularly affecting silver, has been taken in a memorial from the Mining Chamber of Commerce to the taxation department of the Ministry of Finance, petitioning for the duty-free importation of all material, tools and machinery used in the production of silver. Official action on the petition was scheduled to be taken July 9, when it is expected some important modifications will be made in the taxation now weighing on the mining industry.

■

Freeport Drills for Sulphur in Louisiana Area

Freeport Sulphur, a subsidiary of Freeport Texas, has leased from Shell Petroleum sulphur rights on a salt-dome cap-rock area of approximately 700 acres, located at Black Bayou, Cameron Parish, in southwestern Louisiana. Sulphur has been encountered at widely scattered locations in the course of Shell's drilling for oil in this area. According to the leasing agreement, Freeport will drill a minimum of eight prospect wells. Two light rigs have been moved to the property, and drilling started early this month. The depth to the top of the cap rock of this formation ranges from 900 ft. at the apex to 1,300 ft. at the perimeter.

This is the second agreement under which Freeport has undertaken the development of sulphur properties jointly with an oil-producing company, the first being the operation with the Texas Company of Hoskins Mound, from which deposits its greatest sulphur production is now being obtained.

■

Reopen Tough-Oakes Again

The old Tough-Oakes-Burnside property, in Kirkland Lake, Ont., the first producer in the camp, will again be reopened. Some time ago this company went into liquidation. Recently the Master of the Supreme Court sanctioned an option to K. A. MacPhadyen, of Toronto. Should the option be exercised the amount involved would not be sufficient to cover bond indebtedness, so that nothing would be left for shareholders.

Tough-Oakes has produced more than $3,000,000 to date and has paid $400,000 in dividends. Mr. MacPhadyen proposes to explore ground not previously worked.

■

Southwest Area Served by First Sky Ambulance

Mining companies in the Southwest can now avail themselves of the first commercial aërial ambulance, with a speed of 150 miles an hour, in cases where patients must be taken to hospitals or to their homes over great distances and cannot stand the jolts of a ground vehicle. The plane, a Lockheed-Vega with 425-hp. Wasp motor, is owned by the California Aerial Transport Company and will be kept on call at the hangar at the Los Angeles Municipal Airport. Equipment for the plane was supplied by the E. D. Bullard Company, distributors of safety equipment.

■

Tonopah Ex. Cuts Wages as Silver Price Declines

Because of the continued drop in the price of silver, Tonopah Extension, now the only large mining company still in operation in the Tonopah district of Nevada, was forced to cut wages 50c. a shift in the middle of June. Other precious metal mines in western Nevada are following suit. The present wage scale at Tonopah is $5.25 a shift for miners and $4.75 a shift for shovelers. This is the first cut since 1922, when silver sold for $1 an ounce.

Production of Tonopah Extension will be continued indefinitely, as the mine is managing to make more than expenses even with the present low silver price, and a shutdown would result in flooding the entire district. The water level at the mine is being kept below the 1,800 level. About 1,000 g.p.m.is being pumped. The company is employing about 175 men and producing about 60,000 oz. of silver-gold bullion every fortnight.

■

Creighton Reserves Increased

Recent additions to the proven nickel-copper ore reserves of the Creighton mine of International Nickel, at Sudbury, Ont., have assumed quite important proportions. Up to the present, Creighton has contributed the bulk of ore for operations of International Nickel in the Sudbury district. Proved ore as of Dec. 31, 1929, amounted to 5,503,000 tons, equivalent to about 4½ years' supply at the then current rate of production. Since the beginning of the year, diamond drilling and development work has proved the existence of substantial tonnages of additional ore, officially described as of the "customary Creighton grade." Developments are particularly important in that they have proved the continuation of the Creighton ore deposit below a vertical depth of 2,500 ft., the lowest working level in the mine. The new ore is not believed to be a separate orebody, but is thought to be an extension of the original deposit, as it occurs in the same conditions as the other ore in the mine.

New York & Honduras Increases Gold Output as Silver Drops

Because of the drop in the price of silver, New York & Honduras Rosario is increasing its production of ores assaying comparatively high in gold, according to A. R. Gordon, general manager of the property in Central America. The drop in the price of silver to 33⅜c. an ounce by June 26, 1930, is a cause of concern to the company, which lowered production costs in 1929 to 31.24c. an ounce, compared with 36.02c. an ounce in 1929. Further reductions in mining costs are expected as a result of development work, but the margin is a small one.

Ore reserves were increased approximately 84,000 tons, to 358,500 tons on Jan. 1, 1930, with an average grade of 26.6 oz. of silver and 0.13 oz. of gold to the ton. In addition, the company has about 400,000 tons of prospective ore in the Salvador-Fortuna-Carmen and Independencia groups. In 1929, production was 113,920 tons of ore, or a little more than 300 tons daily. New equipment is being added to the company's cyanide plant, including a new 5x22-ft. tube mill, because of the longer period of agitation and finer grinding needed to maintain recovery at about 92 per cent of the metal content.

■

Victoria Gold Mines Are Aided by Government

Gold mining in Victoria, Australia, continues to decline and steps are being taken by the government in an effort to stimulate activity. Production in 1929, for which final figures have recently been released, was valued at £111,609, compared with £144,068 in 1928. The state government has resolved to accede to the request made by the Chamber of Mines that dividends paid by gold-mining companies in Victoria, as well as proceeds from the sale of gold-mining leases, be tax exempt, as from July 1, 1929. Owing to present financial difficulties, however, the subsidy to prospectors has been reduced from £1 to 6s. 8d. for every £1 spent in prospecting.

In the Bendigo district, the most important gold-producing area in the state, if ore must be transported more than 2 miles for metallurgical treatment, the government has agreed to pay two-thirds of the transportation cost if the ore averages less than 5 dwt. a ton; half the cost if the ore averages 5 to 9 dwt.; and a third the cost if it averages from 9 to 12 dwt. Geological surveys recently made by the Department of Mines on the northern extension of the district, near Eaglehawk, have indicated that the zones that were most productive in the central area rise nearer the surface in the newly surveyed section.

■

Mount Coolon Mines Optioned

Development work on the Mount Coolon mines, in Queensland, is being undertaken by Austral Development, which has obtained a three months' option on the properties from British-Australian Mining Exploration. C. G. Gibson, consulting geologist of Austral Development, has outlined a program of exploration for the properties, which produce about three-quarters of Queensland's gold output of 1,100 oz. monthly. The purchase price is said to be £100,000. The properties are about 160 miles south of Charters Towers.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Mount Lyell to Enlarge Mill; May Cut Broken Hill Wages

Melbourne, June 28.—Mount Lyell Mining & Railway will increase concentrator capacity at its plants on the west coast of Tasmania to 1,000 tons of ore daily from the present capacity of about 500 tons daily. This increase will be made partly to permit treating ore from the low-grade Royal and Tharsis orebody, which averages about 2.2 per cent copper as compared with better than 5 per cent ore in the main North Mount Lyell orebody and about 3.2 per cent in the Lyell Comstock orebody. It will also result in increasing the company's annual output from about 8,000 to 13,000 long tons of copper. Large additions to the present known reserves of the Royal and Tharsis orebody are expected below the North Lyell tunnel level.

. . . . Before the end of July, 1,300 men are expected to be thrown out of work in the Broken Hill lead-zinc-silver district, by the closing of the Broken Hill Proprietary, British, and Block 14 mines. The unions have been asked to accept a reduction of 17.5 per cent in wages, which, it is estimated, would enable the mines to continue operations. The estimated profit of the Zinc Corporation, one of the lower-cost Broken Hill mines, in the month of May, based on the April average price for lead (or about £18.3 per ton) and the existing zinc contract rate, was £10,852, or about half the rate usually earned with normal metal prices. Each variation of £1 in the price of lead is estimated to make a corresponding change of about £3,350 in the monthly profits.

. . . . Increased cadmium production at the Risdon plant of Electrolytic Zinc is helping to offset the effect of lower prices for zinc. During the quarter ended March 31, a recent statement declares, the plant recovered 53.8 tons of cadmium, valued at £24,109. Production in the last fiscal year was 176 tons, or about 44 tons quarterly.

. . . . Eight scout drill holes put down by Placer Development on alluvial gold holdings below the junction of the Watut and Bulolo rivers, in New Guinea, have shown very satisfactory grades of wash. The company has acquired a large additional area upstream from its Bulolo leases, which are to be equipped with two new dredges. Its new planes will be delivered in November, when transportation of dredging and power equipment will be started. The existing airdrome at Lae is being enlarged to permit coping with the increased traffic that will result from putting the new planes into operation and an airdrome is being constructed at the dredging site. All supplies and equipment for Placer Development will be handled by plane. Contracts for the power plant are being let.

. . . . Many Australian-controlled tin companies operating small dredges on ground that averages less than 0.75 lb. of tin per cubic yard have suspended operations in Malaya because of the decline in the price of tin. Others are reducing salaries 10 per cent. A meeting of representatives of Malayan tin companies has been held at Sydney to consider the proposal of the Tin Producers' Association for complete suspension of tin mining over a period of three months.

. . . . What may be an important alluvial strike is now being developed at Eaglehawk, near Bendigo, Victoria. At a depth of 22 ft., alluvial wash that averages 6 dwt. in gold per cubic yard has been proved over a length of a mile.

■

Bolivian Tin Exports Drop; Patiño on Four-Day Week

La Paz, Bolivia, June 30.—Exports of Bolivian tin *barilla,* or concentrate averaging 65 per cent tin, were more than 3,000 metric tons less in May than they were in the corresponding month of 1929. Total exports in 1929 were about 81,000 metric tons, or an average of 6,750 metric tons monthly.

. . . . Patiño Mines & Enterprises, largest individual tin-mining company in the world, is now shutting its operations down three days a week, giving evidence that the company is wholeheartedly in the general curtailment program. Araca and Oploca, two of the lower-cost smaller mines, are curtailing output 20 per cent, in accordance with the general practice of the members of the Tin Producers' Association.

. . . . Compañia Minera Monserrat, in the Poopo district, has completely shut down its new 150-ton concentrator. The ore handled at this property is extremely complex, carrying 5 per cent tin, 3 per cent lead, 14 per cent zinc, 20 per cent iron, and 15 oz. of silver to the ton. This is further complicated by the occurrence of about 15 per cent of the tin content in the form of the complex tin sulphide, teallite. The metallurgical problems seemed about to be solved, with recovery of about 70 per cent of the tin content, when the continued drop in the price of tin made the company, financed by Chilean capital, decide to close down.

■

Lake View & Star Completes First Flotation Unit

Kalgoorlie, Western Australia, June 30.—Construction of the first unit of the new flotation plant that Lake View & Star is building on its Chaffers lease, in this district, has been completed and will be put into operation shortly. The unit has a capacity of 150 tons of ore daily and, if it effects the economies in metallurgical treatment expected, will be enlarged eventually to a capacity of 1,400 tons daily. In addition, the new 400-hp. Diesel engine and compressor have been installed at the mine. Driving of the new main haulage tunnel to connect the Ivanhoe and Chaffers shafts at a depth of about 2,800 ft. has been completed for some time.

. . . . Shaft sinking has been started on the Croesus Proprietary property, which is being operated by South Kalgurli under a lease from Oroya Links. The shaft will be put down 150 ft. to the 1,200 level, where development of the orebodies will be undertaken. To date the lease has proved profitable.

. . . . The main hoisting shaft of Wiluna Gold, near Meekatharra, is now below 700 ft. and has only 100 ft. to go to reach its present objective. In the Yalgoo gold field, southeast of Meekatharra, a rich alluvial find has been made, from which 300 oz. of gold is reported to have been won in a short time. Fourteen leases have been pegged to date.

. . . . The first large consignment of ore from the new gold find at Edjudina has been shipped to the Yarra battery, 20 miles distant. About 100 tons of ore is included in this shipment, and returns are awaited with interest because of the length and consistency of the outcrop.

■

Anderson Believes Improvement in Rand Labor Temporary

Johannesburg, June 27.—P. M. Anderson, president of the Transvaal Chamber of Mines, in his address at the quarterly meeting of the organization referred to the still precarious position of the colored labor supply for the Witwatersrand mines. He pointed out that the present success of efforts to increase the number of workers from districts within the Union of South Africa was probably only a temporary result of general depression throughout the country. Other industries are in poor condition and workers discharged have sought employment at the gold mines. As a result, at the end of May the total number of colored workers in Transvaal gold mines was 202,182, compared with 195,733 at the end of May, 1929. Because of his belief that this improvement is only temporary, Mr. Anderson again appealed to the government to recognize the necessity for removing restrictions that now prevent immigration of colored workers from other territories into the Union.

. . . . The outlook at Sub Nigel, largest of the Transvaal gold mines outside the Witwatersrand area proper, has been greatly improved. Working costs are considerably lower. In April, 1930, the average cost was estimated at 41s. 5d. per ton of ore treated, as compared with an average of 45s. 8d. throughout 1929. The tonnage treated monthly

is now almost 30,000, compared with an average of 24,500 in 1929. Development results in the mine, which had been erratic, have recently shown a gratifying consistency. The margin of profit in April—28s. 8d. per ton of ore treated—was exceeded only by the Modder Deep among Transvaal gold mines.

. . . . Sinking of the new No. 3 shaft of Daggafontein Mines, on the Far East Rand, has passed safely through the dolomite formation and is now penetrating the quartzites at a depth of nearly 1,000 ft. This shaft, which will be the main working unit on this prospective new producer, is expected to reach the reef at a depth of 3,800 ft. Two shafts have already been put down on the property to depths of 3,580 and 4,095 ft. respectively.

■

Tin Producers to Close Down for Two or Three Months

London, July 1.—During the last week, the Tin Producers' Association has announced a new step to control production and thereby bolster the price of the metal. The plan is for uniform regulation of output to the agreed extent of a 20 per cent reduction from the 1929 production by a complete suspension of operations for the next two or three months. This step has been advocated by a special international committee of the association sitting last week at Paris. New difficulties have cropped up, however. About 35 per cent of the world's supplies remains outside the jurisdiction of the association.

. . . . The effect of the tin curtailment policy in the Eastern producing fields is reflected in official figures of Straits shipments for June, which were made public in London today. Shipments during the month totaled 8,156 tons, compared with 10,074 tons in May and 9,720 tons in April. The actual figures show a greater curtailment than had been anticipated, as the advance estimate of June shipments was 9,500 tons. Included in the shipments for June were 303 tons taken from stock, as the carry-over has been reduced by that amount. World stocks increased 2,840 tons. The advance estimate of July shipments from the Straits is 8,500 tons. Nigerian figures for May, which have just been made available, also reflect the progress of the curtailment program. Arrivals for the month were 764 tons, compared with 969 tons in April and 1,230 tons in March.

. . . . Apparently the only step the Malayan government is willing to take in the present tin crisis is the suspension of alienation of land for mining purposes. The Malayan government obtains 15 per cent of its revenue from tin, so a two months' stoppage will be almost disastrous to governmental finances. The question also arises as to who will feed the large number of coolies working for Chinese owners during the period of the suspension.

. . . . Consolidated Gold Fields of South Africa is reported to have taken a substantial interest in the tin market, thereby giving support to John Howeson, the moving spirit of the Anglo-Oriental group. Count L. A. G. Dru has resigned from the Consolidated Gold Fields board of directors, and Sir Philip Cunliffe-Lister, chairman of the Tin Producers' Association, M. H. Knatchbull, and Mr. Howeson have been added to it. Through Mr. Howeson, Gold Fields will be indirectly connected with Anglo-Oriental and the Nigerian companies.

. . . . Base-metal markets in London have been noticeably firmer during the last week, but the improvement is felt here to be largely sentimental and not to have any real basis on a bettered statistical position.

. . . . London representatives of Western Australian gold mines have cabled the Premier of Australia urging adoption of a bonus on gold production, thus halting the continued decline in the province's output.

. . . . The Soviet government will make a claim for £1,000,000 against Lena Goldfields for alleged breach of its contract in connection with Siberian gold concessions. The arbitration case has recently been heard in London courts, because action in Berlin proved ineffective. Because the Soviet government was unrepresented at the new hearings, they were adjourned to Aug. 6. The Russian government may file its defense and counter claim before July 19.

■

New Hole at R.C.B.C. Adds to High-Grade Area

London, June 28.—Drill hole No. NE 26 at the N'Changa West Extension property of Rhodesian Congo Border Concession has added considerably to the known extent of the high-grade sulphide area now being developed on that Northern Rhodesian property. It has already cut 63 ft. of 7.7 per cent copper, and according to the latest report was still in ore. This hole proves the continuity of ore in a previously blank half mile east of No. NE 7.

. . . . Several Northern Rhodesian copper companies are understood to be considering a reduction in the amount of diamond drilling at their properties, as the tonnages blocked out already are estimated to contain nearly 15,000,000 tons of copper, which is sufficient to justify equipping the mines to produce 700,000 tons of copper annually. No definite plan to this effect has yet been adopted, but general opinion seems to be that the attention of the management should be centered on opening the mines and building metallurgical plants.

. . . . On the other hand, scout drilling on interesting outcrops or promising geological formations will certainly continue in the hope of finding additional new deposits. This is particularly true of the grants held by Rhodesian Selection Trust within the N'Kana Concession and of Rhodesian Congo Border and Loangwa Concessions, two of the other large concession-holding companies.

. . . . Luiri Gold, Northern Rhodesia's new gold producer, reports that a winze at the Dan Robin property has been in ore for 107 ft., averaging 3½ oz. of gold to the ton over a width of 25 in. In May this company treated 1,543 tons of ore, averaging 43s. 4d. in gold to the ton, or about 10.5 dwt. Recovery averaged 34s. 5d. a ton, the bullion produced being £2.568.

Mansfeld Mine Still Closed; Giesche to Build New Plant

Berlin, June 30. — Mansfeld Copper, which closed down its mines and smelters early in the month because of a wage dispute, is still closed, and notice of dismissal has been given the entire staff, including the managers. Evidently the company has abandoned all hope of resuming operations until either the copper market improves or the workers are willing to accept the wage cut suggested. Mansfeld's annual report for 1929, recently issued, states that the company produced 22,893 metric tons of copper; 123,370 kg. of silver; 2,535 metric tons of lead; and 7,740 tons of zinc oxide. On the basis of present quotations for copper and its other products, Mansfeld would have to operate at a loss of at least 8,000,000 marks annually, provided the wage scale were not changed.

. . . . Concern is expressed in metal circles here that American copper producers, such as Anaconda, that manufacture as well as mine and smelt copper, will be able to offer cheaper manufactured copper in the world markets than German manufacturers, because of the lower cost of their raw materials.

. . . . Otavi Mines & Railway, a German-controlled company operating a property in British South West Africa, has declared a dividend of 16⅔ per cent for operations during 1929-1930, representing an unchanged rate compared with 1928-1929. The company ships copper-lead-silver ores, but to date the decrease in metal prices has not threatened to force suspension of operations. Giesche Spolka Akcyjna, subsidiary of Anaconda Copper, has halved its dividend rate and Silesian Zinc Smelting has passed its dividend.

. . . . Consideration of the proposed tariff on German imports of zinc metal has been postponed until autumn because of the serious protests of large zinc consumers. Construction of the new Georg von Giesche's Erben electrolytic zinc plant at Magdeburg is assured, despite the continued fall in zinc prices. The plant will have a capacity of 150 tons of metal daily.

. . . . No inclination exists to renew the Brussels zinc cartel under the old conditions, and not much progress has been made in outlining new ones. The increase in offerings of American scrap metal recently have led to the fear that American lead and zinc will find their way into European markets because of the depressed conditions in the United States.

. . . . A great deal of interest is being evinced in aluminum alloys here. The European aluminum cartel is not expected to alter its stabilized prices in conformity with the drop in the United States, as it is felt that the Aluminum Company undertook that step only because of the new U. S. tariff, which puts lower rates on aluminum imports.

. . . . In return for a share control of Berg Heckman Selve, Metallgesellschaft has turned over to the latter company all of its copper-rolling mills. Control of Berg Heckman was formerly held by the German government. The company now stands second only to Hirsch Kupfer & Messingwerke among German rolling works.

MARKET AND FINANCIAL NEWS

Consumption of Copper in 1929 by Industries

Estimated consumption of copper in the United States, classified according to industries, according to a compilation by the American Bureau of Metal Statistics, in tons, follows:

	1928	1929
Electrical manufactures	213,000	261,000
Telephones and telegraphs	119,000	164,000
Light and power lines	115,000	127,000
Trolley wire	6,300	6,700
Wire and rods n.e.s. (a)	80,000	95,000
Wire cloth	6,500	6,700
Steam railways electrified	800	500
Automobiles	125,000	135,000
Automobile brake lining	2,400	2,600
Buildings	62,000	59,000
Locomotives	1,500	2,500
Railway cars	3,200	5,600
Air brakes	1,300	1,500
Ships, commercial	1,600	2,000
Ships, naval	300	400
Bearings and bushings	42,000	48,000
Valves and pipe fittings	20,500	22,000
Ammunition	8,200	6,900
Lubricators	5,000	3,500
Condensers	1,900	1,900
Fire-fighting apparatus	2,300	2,400
Agricultural machinery	1,500	1,500
Cash registers	400	400
Copper-bearing steel	1,600	2,600
Coinage	800	1,200
Radio receiving sets	5,100	7,000
Clocks and watches	4,600	4,300
Washing machines	4,200	4,500
Water heaters, household	2,600	2,300
Water meters	3,500	3,900
Refrigerators, electric	13,800	17,200
Plated ware	7,000	6,900
Safety razors	1,500	1,100
Radiators, heating	1,100	1,300
Other uses	50,000	55,000
Manufactures for export	65,600	73,600
Totals	981,100	1,137,000

(a) Not elsewhere specified.

The estimates are based on reports from manufacturers and users. Obviously, the A.B.M.S. points out, an accounting for the consumption of copper by this method cannot be complete and the grand totals are no doubt consistently understated.

■

Atlas Absorbs Mining Issues

Atlas Exploration Company is being formed to take over the entire assets of Atlas Exploration and Mining Issues, two Canadian exploration companies. The new company will have a capital of 5,000,000 shares of no par value, of which 650,000 shares will be issued in exchange for the assets of the two present companies and 250,000 shares will be issued to the public to raise money for development work. The principal asset of the new company is a stockholding of 217,112 shares of Northern Lead & Zinc, which owns claims at Great Slave Lake, Northwest Territory. Consolidated Mining & Smelting, Ventures, Ltd., and Paine, Webber & Company, of Boston, have the remaining shares of Northern Lead & Zinc under control. In addition, the company has about 40 per cent of the issued capital of Duthie Mines, a British Columbia lead-zinc mine, and 20 per cent of the capital of General Explorations, which holds territory adjoining the Northern Lead & Zinc property at Great Slave Lake.

■

Manganese Companies in Merger

The Swann Corporation announces the consolidation of seven of its companies under the name Swann Chemical Company, with a capital of $1,000,000. The companies included in the merger are: Southern Manganese Corporation, manufacturer of ferrophosphorus; Southern Manganese Mining Corporation, Southern Manganese Land Company, Federal Carbide Company, Federal Fertilizer Company, Jax Plant Food Company and Federal Phosphorus Company, manufacturer of phosphoric acid.

■

Tonopah Meeting Adjourns

Stockholders of Tonopah Mining, at a special meeting, took no action on the proposed plan of reorganization and readjustment of the capital structure. The meeting has been adjourned to Oct. 6.

W. L. Haehnlen, president, stated that the proposed plan would require further consideration. He told stockholders that arrangements would be made for new subscription warrants to the Tonopah Corporation. Under the plan the present warrants expire Aug. 1.

In answer to a stockholder's question he stated that none of the Tonopah Mining properties at present is earning a dividend.

■

ANACONDA COPPER MINING has declared a quarterly dividend of 87.5c., payable Aug. 18, compared with previous quarterly dividends of $1.75 quarterly. Other companies in the Anaconda group have also reduced dividends —Andes is now paying $1.50 instead of $3 a year, and Greene Cananea is paying $3 instead of $8.

U. S. SMELTING, REFINING & MINING has cut the dividend rate on common stock because of the current low prices of silver, zinc, and lead, from $3.50 to $1 annually, by declaring a quarterly dividend of $1.

English Copper Manufacturer Attacks Exporters' Policy

A strong attack against the policy of the Copper Exporters' Association was brought by the chairman of the Broughton Copper Company at the recent annual meeting in Manchester, England. The company entered into a contract for a monthly supply of copper at terms which precluded selling it in the form purchased. "If the Copper Exporters' Association had not rushed the price of copper up unduly fast, we should have been able in all probability to have sold this copper in the form of manufactured goods. As it was . . . we sold nothing except on the basis of the reduced price to which the Copper Exporters' Association came down," and it cost the firm many thousands of pounds. Despite adverse trade circumstances, the chairman declared, the Copper Exporters' Association "obstinately maintained their price . . . No one had any faith in their ability to maintain their price, and not one of our buyers would place orders, except for immediate requirements, and where possible bought substitutes." The Broughton directors do not want "to be hampered or at the mercy of a body who control our commodity and who do so in such a manner that ignores economic conditions and the laws of supply and demand."

■

Ontario Gold Output in May

May Ontario gold production declined slightly from the April figures, but made a substantial gain over the record for May, 1929. Both Porcupine and Kirkland Lake produced less in May than in April, although a gain by the miscellaneous producers (as a result of starting operations at the Howey mill, in Red Lake) partly offset this loss. The figures follow:

	1929	1930
Porcupine, May	$1,687,477	$1,545,110
Porcupine, April	1,498,671	1,561,925
Kirkland, May	1,157,028	1,349,969
Kirkland, April	1,200,166	1,393,520
Total, May (a)	2,853,704	2,933,906
Total, April (a)	2,698,837	2,977,296

(a) Includes miscellaneous producers.

■

FREEPORT TEXAS reports for the quarter ended May 31, 1930, net income of $824,376 compared with $1,007,784 in the preceeding quarter and $1,136,482 in the corresponding quarter of last year.

Mining Company Dividends for June, 1930

Companies in the United States	Situation	Per Share	Total Disbursements
American Metal	Various	$0.75 Q	$651,138
American Metal, 6% pfd	Various	1.50 Q	103,014
American Smelting & Refining, pfd	Various	1.75 Q	875,000
Bunker Hill & Sullivan, s. l.	Idaho	0.50 MX	245,250
Calumet & Arizona, c	Arizona	0.50 Q	438,095
Calumet & Hecla, c	Michigan	0.50 Q	1,002,751
Castle Peak, q	Nevada	1.00	20,000
Federal Mining & Smelting, pfd	Idaho, Okla	1.75 Q	126,000
Golden Cycle, g	Colorado	0.40	66,000
Hecla Mining, l. s	Idaho	0.25 Q	250,000
Homestake Mining, g	S. Dakota	0.50 M	125,800
Mayflower Associates, h	Various	0.50 a	150,000
Mother Lode, c	Alaska	0.10	250,000
National Lead	Various	1.25 Q	387,289
Nevada Consolidated Copper	Nev., Ariz., N. M.	0.37½	1,820,666
New Jersey Zinc	Various	0.50 X	981,620
St. Joseph Lead	Various	0.75 QX	1,463,647
Sunshine Mining, s. l.	Idaho	0.05 Q	75,000
Utah Copper	Utah	2.00 Q	3,245,990
Companies in Other Countries			
Chile Copper	Chile	0.75 Q	3,311,624
Hollinger Consolidated Gold	Ontario	0.05 M	246,000
International Nickel, n. c	Ontario	0.25 Q	2,947,161
Lake Shore, g	Ontario	0.30 Q	300,000
Lucky Tiger, g. s	Mexico	0.10	71,533
McIntyre-Porcupine, g	Ontario	0.25 Q	199,500
Total			$19,353,078

s, silver; l, lead; c, copper; n, nickel; g, gold; q, quicksilver; h, holding company; Q, quarterly; M, monthly; X, extra; a, plus bonus payable in stock.

New York & Honduras Rosario

Despite the drop in the price of silver during 1929, New York & Honduras Rosario, Central American silver-gold producer, reports a net profit of $566,857 in 1929, compared with $597,016 in the preceding year. The smallness of this decline can be attributed to a slight increase in the tonnage milled, from 110,600 tons to 113,920 tons, and a sharp drop in costs, from 36.02c. per ounce of silver produced to 31.24c. per ounce. Output was 2,466,095 oz. of silver and 10,246 oz. of gold. Output in 1929 was 2,275,103 oz. of silver and 8,511 oz. of gold. The company has current assets of $2,746,634, current liabilities of $98,604, and a surplus of $1,991,044. Dividends paid in 1929 amounted to $500,000.

■

U. S. Molybdenum Output

In *E.&M.J.* of June 7, a mechanical error resulted in the publication of the molybdenum output of the United States as 3,094,648 lb. This figure should have been 3,904,648 lb., the estimate of the U. S. Bureau of Mines.

■

Cadmium Output Gained

Output of metallic cadmium in the United States in 1929 amounted to 2,481,427 lb., valued at $2,009,956, as reported by producers to the U. S. Bureau of Mines. This is an increase of 32 per cent in quantity over production of 1,875,896 lb. in 1928. The average price reported by producers in 1929 was 81c. a pound, compared with 61c. a pound in 1928. A total of 214,307 lb. of cadmium, valued at $184,527, was imported into the United States during 1929, compared with 233,101 lb., valued at $128,901, in 1928.

In addition to metallic cadmium, domestic manufacturers reported production of the following cadmium compounds in 1929: Cadmium sulphide, cadmium sulphate, cadmium hydrate, cadmium oxide, cadmium chloride, cadmium acetate, and cadmium lithopone. The estimated cadmium content of cadmium compounds produced was 433,300 lb., valued at $498,734.

■

Copper in Better Shape Than Most Industries, Says Ryan

In volume, the copper industry is running at a somewhat better rate, compared with the average of 1929 and previous years, than most basic industries, John D. Ryan stated at a recent directors' meeting of Anaconda Copper, of which he is chairman. Current copper consumption compares favorably with any other period than the peak years of 1928-1929, he averred. Shipments are 77 per cent of those made during the year 1929, he declared in reviewing Anaconda's fabricated products. They are 97.25 per cent of average shipments from 1925 to 1927.

Final Figures on U. S. Output of Precious Metals in 1929

The U. S. Bureau of the Mint, with the co-operation of the U. S. Bureau of Mines, has issued the following statement of the final estimate of refinery production of gold and silver in the United States during 1929:

States	Gold, Ounces	Silver, Ounces[a]
Alaska	374,669	478,973
Alabama	10	.....
Arizona	211,108	7,840,321
California	409,020	1,194,651
Colorado	220,285	4,415,838
Georgia	58	13
Idaho	19,597	9,533,327
Illinois	.....	4,146
Michigan	.....	17,899
Missouri	.....	146,638
Montana	55,854	12,613,580
Nevada	158,941	4,746,750
New Mexico	33,026	1,060,494
North Carolina	174	14,414
Oregon	17,657	37,840
Pennsylvania	745	5,616
South Dakota	312,328	84,465
Tennessee	653	96,146
Texas	1,263	1,042,273
Utah	237,221	17,884,657
Vermont	.....	3,633
Washington	3,972	51,639
Wyoming	48	8
Philippine Islands	151,757	94,547
Totals	2,208,386	61,327,868

[a] The average New York price of bar silver was 53.3c. per ounce.

Comparison with 1928 production indicates reduction in 1929 of about 25,500 oz. of gold and increase in 1929 of 2,865,361 oz. of silver. Comparison with the year of largest production, 1915, when gold amounted to $101,035,700 and silver 74,961,075 oz., gives reduction respectively of $55,384,300 gold and 13,633,207 oz. silver.

■

INDIAN COPPER, operating a property in Bengal, India, made a gross profit of £45,415 in 1929, on a production of 1,635 tons of refined copper. Debenture interest of £16,779 and other charges bring net income down to £9.759.

BURMA CORPORATION, operating a lead-zinc-silver property in India, made an operating profit of £246,990 in the first quarter of 1930, compared with £307,462 in the last quarter of 1929. Production of lead was the same.

Complete Market News and Prices

THE semi-monthly magazine you are now reading carries only a condensed review of important market news and price movements. For buyers and sellers of ores, metals, minerals, and scrap who require reliable information as soon as it is available, we now provide *Metal and Mineral Markets*, which goes to press at the close of the metal-market week each Wednesday. It is printed at high speed and is in the mails that evening. In compact form, ready for insertion in a ring binder, it is ideal for desk and reference use. It carries the standard *E.&M.J.* quotations used in contracts the world over, recognized as authoritative and dependable. *Metal and Mineral Markets* is priced to subscribers in the United States and its possessions at $2 per annum; to countries in the Americas but outside the United States, $5; elsewhere, $10 yearly: 52 issues. Address *M.&M.M.*, 36th St. and 10th Ave., N.Y.C.

Average Metal Prices for June, 1930

COPPER:	
Electrolytic, refinery	12.049
London Standard Spot	50.003
London Electrolytic Spot	56.750
LEAD:	
New York	5.410
St. Louis	5.310
London Spot	17.941
London Forward	17.994
SILVER:	
New York	34.595
London	16.049
Sterling Exchange	485.625
ZINC:	
St. Louis	4.441
London Spot	16.422
London Forward	17.038
TIN:	
Straits	30.336
London Standard Spot	136.300
QUICKSILVER	118.600
ANTIMONY	7.057
PLATINUM:	
Refined	46.000
ALUMINUM 99 Per Cent Plus	24.140

■

U. S. Asbestos Output Increased in 1929

Asbestos producers in the United States sold or used 3,155 tons in 1929, valued at $351,004, according to the U. S. Bureau of Mines. These figures represent 1,983 tons of chrysotile, valued at $317,584, mined in Arizona and Vermont, and 1,172 tons of amphibole, valued at $33,420, mined in Georgia, Maryland, Montana, and North Carolina. Compared with the record for 1928, chrysotile showed an increase in quantity but a decrease in value, whereas amphibole showed increases in both quantity and value.

Figures for chrysotile include both crude and mill fiber, high-grade and low-grade fiber. Amphibole is also produced as long and short fiber. High-grade long fiber from Maryland has been used since 1918 for making chemical filters.

■

Why Gold Advanced

The reason for the advance in the London gold quotation on June 11, from 84s. 11½d. to 85s. 0⅜d., has been explained. The Bank of England decided to deliver to buyers gold of 916.6 fineness (standard fineness) instead of fine gold as heretofore. This low quality is unacceptable to the Bank of France, so the metal has to be refined up to 995, involving the loss of one day's interest and a charge of ¾d. per ounce, gross. The effect of this was that £476,000 of South African gold was sold at 85s. 0⅜d., the premium of ⅞d. over 84s. 11½. (the Bank's selling price) being the equivalent of the refining and interest charges.

Lead, Zinc, and Aluminum Prices Decline —Copper Fairly Stable

New York, July 7, 1930.—Some signs of stability and improvement are evident in the non-ferrous metal market in spite of the new low prices for lead, zinc, silver, and aluminum that were witnessed in the closing weeks of June and in the first few days of July. Copper sales have been very satisfactory at varying prices between 11½ and 12c., and lead business was also excellent for a week, after recent price reductions. Tin prices for a time reacted definitely above 30c., and zinc has turned upward from its low point of 4.10c., which may or may not prove to have been the bottom of the movement. Of the other metals, aluminum was reduced 1c. per lb., and antimony has been slightly easier at 7c.

THE large copper producers have continued to quote 12c., delivered, since the middle of June, and on some days have done a fair business at that level. Custom smelters, on the other hand, have had to quote lower prices than that to sell their intake, and have booked considerable tonnages as low as 11½c. The supply at the lower figure has not always been sufficient to meet the demand so far, as several of the large consumers are willing to pick up the metal at that price as a speculation. In the last two or three weeks more copper has been bought, in all probability, than has been used, for neither the brass nor the wire mills have yet seen much improvement in their business, even at the admittedly low prices now obtaining.

Foreign demand has been comparatively more quiet than domestic, for buyers are not willing to pay the export association's price of 12.30c., c.i.f., when they know that copper is available on this side for less than 12c.

Current production rates are being curtailed further, as it is generally believed that stocks of copper are continuing to accumulate.

On June 23 the American Smelting & Refining Company made another reduction in its contract price of lead, to 5¼c., New York, and business was rather lively for a few days, particularly in the Middle West. Since then activity has subsided again, and the week before the Fourth of July was more quiet than usual, with some offerings of small resale lots at slight concessions in price. Large consumers have felt that lead was cheap and have bought fairly liberally, but it is becoming evident that in the last two months a very real drop in the consumption of lead has come about, this having occurred somewhat later than the shrinkage in the use of some of the other metals that have been involved in the industrial slump. Current purchases are largely confined to carloads for prompt shipment, though July requirements have been fairly well provided for. The London market is well above domestic parity, and had no influence on the drop here.

Galena in Joplin sold at $62.50, 80 per cent basis, in the week ended June 21, and at $60 in the weeks ended June 28 and July 5.

Producers continued to cut zinc prices in the hope of stimulating trade until on July 1 a low of 4.10c. was reached. This looked like a good speculation to many consumers, who tried in vain to book orders for far forward shipment at that level. Sellers then reversed their tactics and tried advancing prices to 4.15@4.175c., but that apparently did not scare consumers to the extent intended, and the market has been decidedly quiet ever since the middle of June. American Zinc Institute statistics show that the rate of production actually increased during June, at 1,449 tons a day, compared with 1,438 in May. Shipments declined from 38,889 to 36,670 tons, so the stocks, of course, increased again, from 102,775 to a total of 109,578 tons.

Prime Western blende in the Joplin market, basis 60 per cent, has been $29 for the weeks ended June 21, 28, and July 5; flotation, $28.

Tin went above 30c. on June 19, and except for two days has stayed there ever since. The advance was based on expectations rather than realities, and consumers have remained aloof. The plan is to have about half of the producers shut down during July and the other half during August, and thereafter to curtail their regular production by 20 per cent. If effective, such a curtailment in production would, without doubt, result in a stronger market. Forward tin has sold for about 15 points per month premium over the price of prompt Straits.

Silver hit a new all-time low on June 21, at 33¼c., and has not been far above that level since. Demand has not been active, but some of the London dealers seem to think a temporary stability around present levels may be achieved.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

ALUMINUM—On June 26 the Aluminum Company of America reduced its prices 1c. per pound, equivalent to the reduction in the tariff, making the price for commercial ingot, 99 per cent, delivered, 23.30c.; metallurgical ingot, 94 per cent, 21.30c.; and No. 12 alloy, 22c. In the outside market, 98@99 per cent virgin was reduced to 22.90c., and remelted, 20c. The market has continued dull since the reduction.

Daily Prices of Metals

June / July	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
19	11.625	31.00	5.40	5.30	4.40
20	11.775	30.375	5.40	5.30	4.35 @4.425
21	11.775	30.25	5.40	5.30	4.35
23	11.775	29.75	5.25	5.15	4.30 @4.35
24	11.775	30.50	5.25	5.15	4.30
25	11.775	31.125	5.25	5.15	4.225@4.25
Average	11.750	30.500	5.325	5.225	4.333
26	11.775	30.50	5.25	5.15	4.20
27	11.35	30.75	5.25	5.15	4.15
28	11.55	30.875	5.25	5.15	4.15
30	11.70	30.375	5.25	5.15	4.10 @4.125
1	11.725	30.125	5.25	5.15	4.10
2	11.275	30.25	5.25	5.15	4.15
Average	11.563	30.479	5.250	5.150	4.144

Average prices for calendar week ended June 21, 1930, are: Copper, 11.642c.; Straits tin, 30.083c.; New York lead, 5.417c.; St. Louis lead, 5.317c.; Zinc, 4.406c.; and Silver, 33.813c.

Average prices for calendar week ended June 28, 1930, are: Copper, 11.667c.; Straits tin, 30.583c.; New York lead, 5.250c.; St. Louis lead, 5.150c.; Zinc, 4.227c.; and Silver, 33.792c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

June	Sterling Exchange "Checks"	Silver		Gold London	June July	Sterling Exchange "Checks	Silver		Gold London
		New York	London				New York	London	
19	4.85 1/2	34 1/2	15 15/16	85s . . . d	26	4.85 13/16	33 5/8	15 1/2	85s . . d
20	4.85 5/8	33 3/4	15 13/16	85s . . . d	27	4.85 7/8	34 1/8	15 15/16	85s . . d
21	4.85 5/8	33 1/4	15 1/2	. . . . .	28	4.85 7/8	34 3/8	16	. . . . .
23	4.85 9/16	33 5/8	15 5/8	85s . . . d	30	4.85 7/8	33 5/8	15 3/4	85s . . d
24	4.85 11/16	33 3/8	15 7/16	85s00 1/4 d	1	4.85 13/16	33 3/4	15 11/16	85s0 3/8 d
25	4.85 13/16	33 5/8	15 9/16	84s11 1/4 d	2	4.86	33 1/2	15 9/16	85s0 3/8 d

Average for week ended June 25: Silver, 33.625c.; Sterling Exchange, $4.85635.
Average for week ended July 2: Silver, 33.833c.; Sterling Exchange, $4.85875.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command nine-thirty-seconds cent premium.

London

June / July	Copper Standard		Electrolytic	Tin		Lead		Zinc	
	Spot	3 M		Spot	3M	Spot	3M	Spot	3M
19	50 1/4	50 1/2	53 1/2	138 1/4	140	17 7/8	17 7/8	16 5/8	17 3/16
20	49 3/4	49 3/4	55 1/2	138 3/4	140 1/2	17 5/8	17 5/8	16 9/16	17 1/16
23	48 3/8	48 3/8	54 1/2	134 1/2	136 1/8	18	18	16 1/2	16 7/8
24	48 7/8	48 7/8	54 1/2	136 5/8	138 1/2	18	18	16 1/4	16 3/4
25	48 1/2	48 1/2	54 1/2	139 1/2	141 1/2	17 13/16	17 15/16	16 1/8	16 11/16
26	49 1/4	49 1/4	54 1/2	136 1/2	138 1/2	18	17 15/16	16 1/8	16 11/16
27	49 1/4	49 3/16	54 1/2	137 5/8	139 1/2	18 3/16	18	16 1/16	16 5/8
30	49 1/8	49	54 1/2	136 5/8	138 5/8	18 3/16	18 1/16	16 3/16	16 1/2
1	50	49 1/2	54 1/2	135 5/8	137 5/8	18 1/16	18 1/16	15 15/16	16 9/16
2	49 11/16	48 7/8	54 1/2	136 5/8	138 5/8	17 7/8	17 7/8	15 13/16	16 7/16

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

ANTIMONY—Per lb., duty paid: Chinese brands, spot, 7c. Futures, 4 7/8c. in bond. Business at a standstill. Mexican nominally 7 1/4c. Cookson's "C" grade spot, 12 7/8c. C.M.C. 99.9 per cent pure, spot, 10 3/4c.

BISMUTH—Per lb., $1 in ton lots.

CADMIUM—Per lb., 70c. in ton lots.

COBALT—Per lb., $2.50 for spot.

IRIDIUM—Per oz., $250@$265.

MAGNESIUM—Per lb., 65c.@$1, 99 1/2 per cent ingots.

NICKEL—Per lb., spot ingot and electrolytic (99.9 per cent), 35c.; shot, 36c. Contracts less.

OSMIUM—Per oz., $70@$75.

PALLADIUM—Per oz., $23@$24.

PLATINUM—Official price quoted by the leading interests on small orders for the refined metal, $46 per oz. Transactions between dealers and refiners in the outside market are reported at $42@$45.

QUICKSILVER—Per 76-lb. flask, $117 @$119. Quiet.

RHODIUM—Per oz., $50@$55.

RUTHENIUM—Per oz., $40@$42.

Prices of Chromium, Germanium Dioxide, Indium, Lithium, Molybdenum, Radium, Selenium, Tantalum, Tellurium, Thallium, Titanium, and Tungsten are unchanged from the issue of June 23.

Metallic Ores

Prices in tons of 2,000 lb., or in "units" of 20 lb., unless otherwise qualified.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $20 for 46@47 per cent Cr_2O_3 ore, and $24 for 50@51 per cent ore.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports in cargo lots, exclusive of duty: Brazilian and Indian ores, 46@48 per cent, Mn, 28c.; Caucasian, 52@55 per cent, 30c.; South African, 52@54 per cent, nominal at 28@29c. Market very quiet.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite, $12@$12.50 for spot and near-by delivery. Nominal. Scheelite from the West, $14; imported, $13@ $13.50; both nominal in absence of actual business.

Iron, Beryllium, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the June 23 issue.

Other Minerals and Metals

Other minerals and metals are substantially unchanged from the quotations in the June 23 issue except:

FERROTUNGSTEN—Reduced to $1.20@ $1.25.

MUNTZ METAL—Reduced 1/4c. to 18 1/4c. for rods and 20 3/4c. for plates.

NICKEL SILVER—Reduced 1/4c. on all grades.

PHOSPHOR BRONZE—Reduced 1/4c. on all grades.

SHEET COPPER—Reduced 1/2c. to 21 1/4c.

IRON—Bessemer reduced to $18.50@ $19; Basic and No. 2 foundry, $18@ $18.50.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1929	1930	1929	1930	1929	1930
January	57.019	45.00	26.257	20.896	484.577	486.447
February	56.210	43.193	25.904	20.008	484.787	485.784
March	56.346	41.654	26.000	19.298	484.776	485.933
April	55.668	42.428	25.738	19.554	484.808	486.019
May	54.125	40.736	25.084	18.850	484.599	485.724
June	52.415	.....	24.258	.....	484.330	.....
July	52.510	.....	24.289	.....	484.560	.....
August	52.579	.....	24.288	.....	484.368	.....
September	51.042	.....	23.708	.....	484.253	.....
October	49.913	.....	23.042	.....	486.392	.....
November	49.615	.....	22.690	.....	487.104	.....
December	48.475	.....	22.258	.....	487.523	.....
Year	52.993	.....	24.460	.....	485.173	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery		London Spot			
	Electrolytic		Standard		Electrolytic	
	1929	1930	1929	1930	1929	1930
January	16.603	17.775	75.551	71.469	78.602	83.250
February	17.727	17.775	78.228	71.419	83.538	83.500
March	21.257	17.775	89.153	69.202	98.356	83.405
April	19.500	15.621	81.036	62.075	89.405	74.338
May	17.775	12.756	75.026	53.159	83.727	59.545
June	17.775	.....	74.338	.....	84.013	.....
July	17.775	.....	72.152	.....	84.043	.....
August	17.775	.....	73.783	.....	84.250	.....
September	17.775	.....	75.286	.....	84.363	.....
October	17.775	.....	72.815	.....	83.978	.....
November	17.775	.....	69.324	.....	82.202	.....
December	17.775	.....	68.303	.....	82.569	.....
Year	18.107	.....	75.416	.....	84.921	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London			
	1929	1930	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.650	6.250	6.498	6.100	22.111	22.344	21.545	21.571
February	6.853	6.236	6.739	6.086	23.128	23.156	21.188	21.097
March	7.450	5.662	7.348	5.542	25.409	25.591	18.807	18.940
April	7.187	5.537	7.025	5.428	24.783	24.408	18.319	18.363
May	7.000	5.523	6.761	5.408	23.949	23.750	17.795	17.861
June	7.000	.....	6.790	.....	23.694	23.603	.....	.....
July	6.804	.....	6.607	.....	22.810	22.880	.....	.....
August	6.750	.....	6.553	.....	23.185	23.259	.....	.....
September	6.890	.....	6.689	.....	23.557	23.589	.....	.....
October	6.873	.....	6.674	.....	23.226	23.253	.....	.....
November	6.285	.....	6.135	.....	21.622	21.643	.....	.....
December	6.250	.....	6.100	.....	21.472	21.484	.....	.....
Year	6.833	.....	6.660	.....	23.246	23.247	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London	
	1929	1930	1929	1930
	Straits		Spot	
January	49.139	38.851	222.727	175.460
February	49.347	38.676	223.138	173.750
March	48.870	36.798	220.781	164.851
April	45.858	36.077	206.887	162.638
May	43.904	32.108	197.545	144.818
June	44.240	.....	200.206	.....
July	46.281	.....	209.473	.....
August	46.619	.....	209.815	.....
September	45.359	.....	204.863	.....
October	42.290	.....	190.783	.....
November	40.208	.....	180.565	.....
December	39.745	.....	179.419	.....
Year	45.155	.....	203.850	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1929	1930	1929 Spot	1929 3 Mos.	1930 Spot	1930 3 Mos.
January	6.350	5.229	26.196	26.233	19.634	20.241
February	6.350	5.180	26.247	26.347	19.209	19.778
March	6.463	4.934	27.050	27.294	18.304	18.810
April	6.658	4.843	26.759	26.613	17.819	18.378
May	6.618	4.641	26.727	26.619	16.670	17.293
June	6.686	.....	26.216	25.984	.....	.....
July	6.766	.....	25.332	25.418	.....	.....
August	6.800	.....	24.896	25.164	.....	.....
September	6.799	.....	24.208	24.688	.....	.....
October	6.740	.....	22.927	23.329	.....	.....
November	6.242	.....	20.851	21.351	.....	.....
December	5.666	.....	20.072	20.672	.....	.....
Year	6.512	.....	24.790	24.976	.....	.....

St. Louis quotations, cents per pound. London pounds sterling per long ton.

Antimony, Quicksilver, and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1929	1930	1929	1930	1929	1930	1929	1930
Jan.	9.558	8.606	119.481	121.192	70.000	61.923	60.000	51.923
Feb.	9.548	8.830	119.818	120.500	70.000	59.909	60.000	51.909
March	9.531	8.236	121.904	118.808	70.000	54.769	60.000	46.769
April	9.462	7.740	122.000	114.000	70.000	46.462	60.000	38.462
May	8.957	7.454	121.154	117.269	68.615	46.000	58.615	38.000
June	8.845	...	120.500	...	68.000	...	58.000	...
July	8.543	...	121.654	...	68.000	...	58.000	...
Aug.	8.778	...	125.111	...	68.000	...	58.000	...
Sept.	8.709	...	124.542	...	66.000	...	56.000	...
Oct.	8.538	...	124.298	...	65.000	...	55.000	...
Nov.	8.583	...	123.323	...	65.000	...	55.000	...
Dec.	8.420	...	121.950	...	63.240	...	53.240	...
Year.	8.956	...	122.145	.....	67.655	...	57.655	...

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce. Price of crude based on refined platinum content.

Pig Iron[1] and Aluminum

	Bessemer		Basic		No. 2 Foundry		Aluminum	
	1929	1930	1929	1930	1929	1930	1929	1930
Jan.	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
Feb.	18.00	19.00	17.50	18.50	17.50	18.50	24.300	24.300
March	18.19	19.00	17.62	18.50	17.69	18.50	24.300	24.300
April	18.50	19.00	18.00	18.50	18.00	18.50	24.300	24.300
May	18.81	19.00	18.31	18.50	18.31	18.50	24.300	24.300
June	19.00	...	18.50	...	18.50	...	24.300	...
July	19.00	...	18.50	...	18.50	...	24.300	...
Aug.	19.00	...	18.50	...	18.50	...	24.300	...
Sept.	19.00	...	18.50	.....	18.50	...	24.300	.....
Oct.	19.00	.....	18.50	.....	18.50	...	24.300	...
Nov.	19.00	...	18.50	...	18.50	...	24.300	...
Dec.	19.00	..	18.50	.....	18.50	...	24.300	....
Year.	18.71	.. ..	18.20	.....	18.21	....	24.300	..

Iron in dollars per long ton. Aluminum in cents per pound, 99 per cent grade.

[1]F.o.b. Mahoning and Shenango valley furnaces; freight to Pittsburgh, $1.76.

Monthly Crude Copper Output in Short Tons

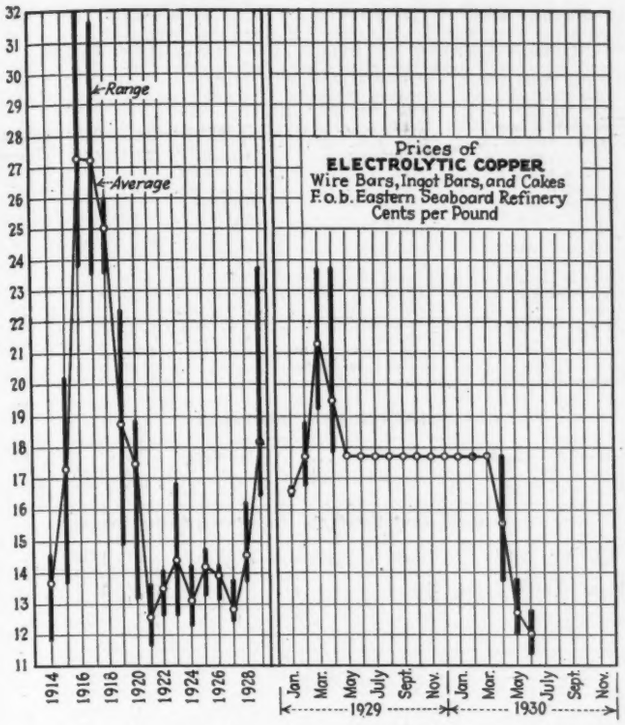
	1929 Total	1929 Dec.	1930 Jan.	1930 Feb.	1930 March	1930 April
Domestic						
Alaska shipments	21,947	2,275	1,219	1,298	2,109	1,416
Calumet & Arizona	65,246	5,132	4,591	3,665	3,550	3,752
Magma	19,118	1,377	1,168	1,068	1,178	1,309
Miami	29,569	2,609	2,807	2,564	3,081	2,762
Nevada Cons.	133,140	(d) 27,543	.....	.....	(d) 19,850	.....
Old Dominion (a)	11,172	830	955	843	885	1,045
Phelps Dodge (b)	111,026	8,200	7,188	6,037	6,048	6,034
United Verde Extens.	29,669	2,371	2,223	1,869	1,681	2,047
Utah Copper	148,312	.....	.....	.....	.....	.....
Tennessee Copper	7,870	705	713	659	672	653
Foreign						
Andes Copper	83,718	5,634	4,779	3,699	.....	.....
Braden	88,155	6,766	4,519	4,618	.....	.....
Boleo, Mexico	13,196	(d) 3,542	.....	.....	(d) 3,537	.....
Bwana M'Kubwa	6,988	598	612	659	556	525
Chile	150,247	8,743	7,492	7,488	.....	.....
Furukawa, Japan	17,767	1,552	1,308	1,604	1,627	.....
Granby Cons., Canada	30,424	2,345	1,985	1,791	1,726	1,891
Howe Sound	21,516	.....	.....	.....	(d) 5,876	.....
Messina	(c) 7,200	588	641	554	655	576
Mt. Lyell	7,600	624	.....	.....	(d) 3,035	.....
Sumitomo, Japan	20,180	1,612	1,396	1,207	.....	.....
Union Miniere, Africa	149,872	.....	.....	.....	.....	.....

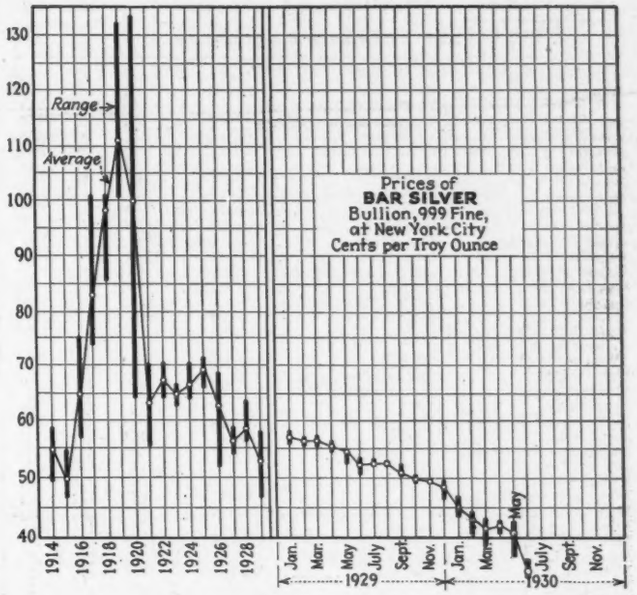
(a) Includes Arizona Commercial. (b) Moctezuma is included. (c) Estimated (d) Three months.

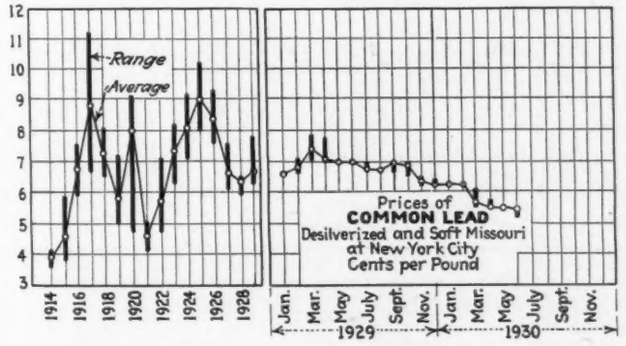
Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

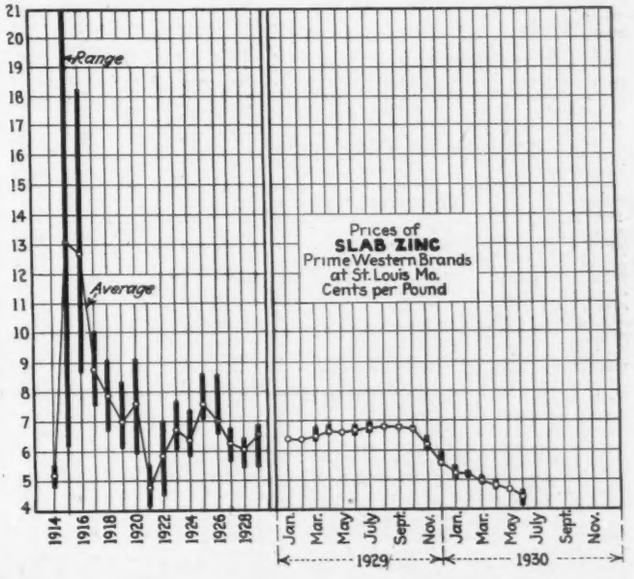
	1928		1929		1930	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	68,469	2,209	86,324	2,785	67,838	2,188
February	67,423	2,352	84,735	3,026	59,196	2,114
March	70,327	2,269	93,698	3,023	61,216	1,975
April	69,721	2,324	94,902	3,163	60,338	2,011
May	73,729	2,378	93,392	3,013	.....	.....
June	73,224	2,441	82,354	2,745	.....	.....
July	73,426	2,369	79,229	2,556	.....	.....
August	76,952	2,482	78,885	2,545	.....	.....
September	78,341	2,611	79,402	2,647	.....	.....
October	86,480	2,790	82,575	2,664	.....	.....
November	85,382	2,846	75,934	2,531	.....	.....
December	85,677	2,764	74,772	2,412	.....	.....
Total	909,051	.....	1,006,203	.....	248,588	.....
Monthly average	75,754	.....	83,850	.....	.....	.....
Av. of daily rate	.....	2,484	.....	2,757	.....	2,072

Metal Price Curves

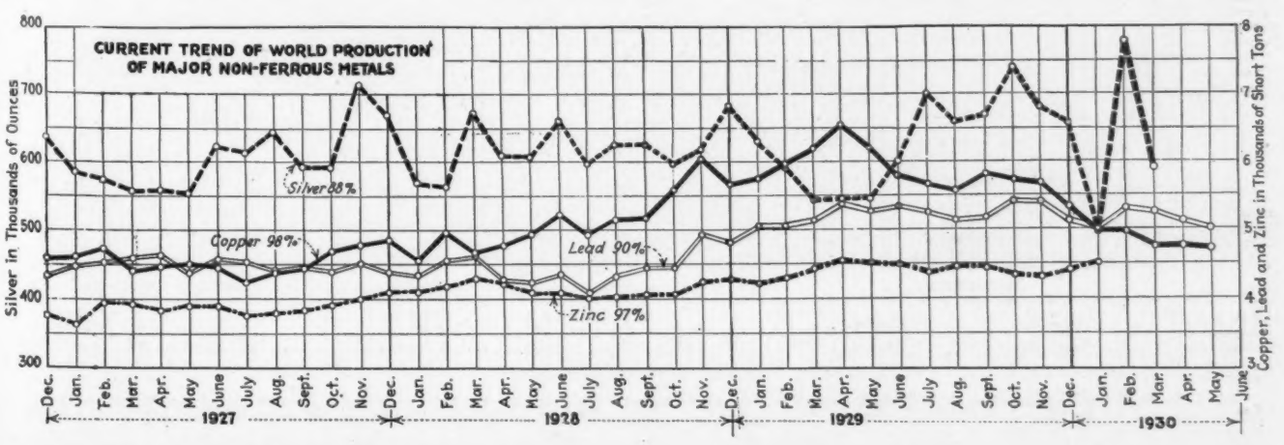

Range
Average
Prices of
ELECTROLYTIC COPPER
Wire Bars, Ingot Bars, and Cakes
F.o.b. Eastern Seaboard Refinery
Cents per Pound
1914 1916 1918 1920 1922 1924 1926 1928
Jan. Mar. May July Sept. Nov. Jan. Mar. May July Sept. Nov.
1929 1930







THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The zinc curve has not been plotted for the past months of 1930, owing to the absence of some European production statistics; this situation is believed to be only temporary in character. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver in Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88%
Copper 98%
Lead 90%
Zinc 97%
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1927 1928 1929 1930

Mining Share Prices—Month of June, 1930

Company Name	Metals Produced	Location of Properties	High	Low	Last
NEW YORK STOCK EXCHANGE					
Ahumada Lead	Lead, silver	Mexico	0.87½	0.62½	0.62½
Alaska Juneau	Gold	Alaska	7.00	4.50	5.12½
Am. Metal	Lead, silver, zinc	Various	40⅜	30⅛	34
Am. Metal, pfd	Copper, gold	Various	112⅝	109	109
Am. Sm. & Ref	Lead, copper, silver	Various	75⅜	53	56½
Am. Sm. & Ref., pfd.	Gold, zinc	Various	140	136½	136½
Am. Zinc., L. & S.	Zinc, lead	Various	12	6.50	8.00
Am. Zinc, L. & S., pfd.	Zinc, lead	Various	65⅛	50	58
Anaconda	Copper, zinc, silver	Various	61⅛	44⅛	50
Andes Copper	Copper, silver	Chile	27⅞	18	23⅛
Butte C. & Z.	Manganese, zinc	Montana	3.00	2.25	2.25
Butte & Superior	Zinc, silver	Montana	2.87½	2.25	2.25
Callahan Zinc-Lead	Lead, zinc	Idaho	1.25	1.00	1.00
Cal. & Arizona	Copper, gold, silver	Arizona	64⅛	48⅛	53
Cal. & Hecla	Copper	Michigan	19⅛	13	15⅛
Cerro de Pasco	Copper, silver, lead	Peru	55⅛	43⅛	44⅛
Dome Mines	Gold	Ontario	9.00	8.12½	8.37½
Federal M. & S.	Lead, zinc, silver	Idaho, Tri-State			150*
Federal M. & S., pfd.	Lead, zinc, silver	Idaho, Tri-State	100	96⅛	96⅛
Freeport Texas	Sulphur	Texas	51⅛	37	38⅛
Granby Con	Copper, silver, gold	Brit. Col.	32⅛	18	21⅛
Greene Cananea	Copper, silver, gold	Mexico	77	77	77
Homestake	Gold	So. Dakota	78	75	75
Howe Sound	Copper, lead, zinc	Various	33⅛	25⅛	26⅛
Inspiration	Copper	Arizona	20⅞	12⅛	14⅞
International Nickel	Nickel, copper	Ontario	33⅛	21	23⅞
Int. Nickel, pfd.	Nickel, copper	Ontario	123	119⅛	123
Kennecott	Copper, gold, silver	Various	49	37⅛	39⅛
McIntyre-Porcupine	Gold	Ontario	18⅛	17⅛	17⅛
Magma Copper	Copper, silver, gold	Arizona	36	28⅛	33⅛
Miami Copper	Copper	Arizona	22	15	16
Mother Lode	Copper, silver	Alaska	1.62½	1.12½	1.12½
National Lead	Lead, zinc	Various	146½	125	129
National Lead, pfd. A	Lead, zinc	Various	141½	140	140
National Lead, pfd. B	Lead, zinc	Various	118	118	118
Nevada Con	Copper, gold, silver	Various	21⅛	15⅛	16⅛
Park Utah Con	Zinc, silver, lead	Utah	2.75	1.62½	1.87½
Patiño M. & E.	Tin	Bolivia	21⅜	17	18
Phelps Dodge	Copper, gold, silver	Various	38	29⅛	32⅛
Rand Mines	Gold	Africa	36⅜	35	35
St. Joseph Lead	Lead, zinc, silver	Various	44	33⅛	35
Seneca Copper	Copper	Michigan	1.75	1.37½	1.37½
Tennessee C. & C.	Copper, su. acid	Tennessee	14⅛	10⅛	12
Texas Gulf	Sulphur	Texas	60⅜	50	52⅛
U. S. S. R. & M.	Silver, gold, lead	Various	28	17⅛	18⅛
U. S. S. R. & M., pfd.	Zinc, copper	Various	49⅛	47	47
Utah Copper	Copper, gold, silver	Utah			190*
Vanadium Corp	Vanadium, ilmenite	Various	124	66⅛	80⅜
NEW YORK CURB EXCHANGE					
Aluminum Co. of Am.	Aluminum	Various	303	210	245
Alum. Co. of Am.,pfd.	Aluminum	Various	109⅜	106⅛	106⅛
Anglo-Chilean Con	Nitrate	Chile	40⅜	25	26⅛
Bunker H. & S.	Lead, silver, zinc	Idaho	68	68	68
Carnegie Metals	Silver, gold	Mexico	7.37½	6.25	7.37½
Con. Coppermines	Copper, gold, silver	Nevada	5.87½	3.62½	4.25
Copper Range	Copper	Michigan	12	10	10
Cresson Con	Gold	Colorado	0.31¼	0.25	0.31¼
Cusi Mexicana	Lead, zinc, silver	Mexico	1.75	0.75	1.00
Evans-Wallower	Lead, zinc	Various	2.75	2.00	2.00
Federated Metals	Trading	Various	19⅛	16⅛	16⅛
Hecla Mining	Lead, silver, zinc	Idaho	12	9.00	9.00
Hollinger Con	Gold	Ontario	6.37½	5.25	5.87½
Hudson Bay M. & S.	Copper, zinc	Manitoba	10	7.00	8.12½
Iron Cap Copper	Copper, silver, gold	Arizona	2.00	1.50	1.50
Mayflower Assoc	Holding	Various	69	57½	61
Mining Corporation	Silver, lead, zinc	Canada	1.25	1.12½	1.12½
New Jersey Zinc	Zinc, lead, silver	Various	76⅛	65⅛	65⅛
Newmont Mining	Holding, copper, gold	Various	118¼	79⅛	90
N. Y. and Honduras	Silver, gold	Honduras	9.75	9.00	9.00
Nipissing	Silver	Ontario	1.50	1.00	1.25
Noranda Mines	Copper, gold, silver	Quebec	29⅛	20⅛	21⅞
Ohio Copper	Copper, lead, gold	Utah	0.75	0.50	0.50
Premier Gold	Silver, gold	Brit. Col.	1.00	0.75	0.87½
Quincy	Copper	Michigan	20	19½	19½
Shattuck Denn	Copper, gold, silver	Arizona	5.87½	5.00	5.12½
So. Am. Gold & Plat	Platinum, gold	Colombia	1.37½	1.12½	1.25
Teck-Hughes	Gold	Ontario	7.50	6.12½	6.50
Tonopah Ex	Silver, gold	Nevada			0.10*
Tonopah Mining	Silver, gold, copper	Various	0.87½	0.75	0.81¼
United Eastern	Silver, lead	Mexico	0.06⅛	0.06⅛	0.06⅛
United Verde Ex	Copper, gold, silver	Arizona	11½	9.00	10
United Zinc Sm	Lead, zinc	Tri-State	3.25	3.25	3.25
Utah-Apex	Lead, zinc, copper	Utah	2.00	1.62½	1.75
Wenden Copper	Copper, silver	Arizona	0.37½	0.25	0.25
Yukon Gold	Gold	Yukon			0.43¾*
BOSTON STOCK EXCHANGE					
Ariz. Comm	Copper, gold, silver	Arizona	1.37½	1.37½	1.37½
East Butte	Copper, gold	Montana	1.00	1.00	1.00
Isle Royale	Copper	Michigan	8.00	6.00	6.00
Mohawk Mining	Copper	Michigan	0.33	0.24	0.24
Old Dominion	Copper, gold, silver	Arizona	6.00	4.00	4.25
Utah Met. & Tunnel	Copper, lead, gold	Utah	0.55	0.25	0.40
MONTREAL					
Asbestos Corp	Asbestos	Quebec	1¼	1	1
Asbestos Corp., pfd.	Asbestos	Quebec	5	3	3
Consolidated M. & S.	Lead, zinc, silver	Canada	220	117	190

Company Name	Metals Produced	Location of Properties	High	Low	Last
TORONTO STANDARD STOCK AND MINING EXCHANGE					
Abana Mines	Copper, zinc, silver	Quebec	0.84	0.45	0.50
Amulet Mines	Copper, zinc, silver	Quebec	0.85	0.45	0.45
Base Metals	Lead, zinc, silver	Brit. Col.	3.10	2.00	2.15
Barry-Hollinger	Gold	Ontario	0.15	0.12	0.14
Canam Metals	Lead, zinc, silver	Various	0.17	0.15	0.16
Castle-Trethewey	Silver	Ontario	0.19	0.16	0.16
Central Manitoba	Gold	Manitoba	0.13	0.09	0.09
Coniagas	Holding, silver	Ontario			0.80*
Falconbridge	Nickel, copper	Ontario	3.90	2.50	2.85
Howey Mines	Gold	Ontario	1.09	0.45	0.52
Keeley	Silver	Ontario	0.31	0.30	0.30
Kirkland Lake	Gold	Ontario	0.75	0.55	0.60
Lake Shore	Gold	Ontario	23	21⅛	21⅛
Sherritt Gordon	Copper, zinc, silver	Manitoba	2.10	1.25	1.34
Siscoe Gold	Gold	Quebec	0.33	0.25	0.27
Sylvanite	Gold	Ontario	0.55	0.42	0.42
Treadwell Yukon	Lead, zinc, silver	Various	5.75	3.50	3.50
Ventures	Holding	Various	1.85	1.05	1.10
Vipond Con	Gold	Ontario	1.42	1.20	1.20
Waite-A.-M	Copper, zinc, gold	Quebec	2.60	1.40	1.42
Wright-Hargreaves	Gold	Ontario	2.30	1.77	1.95
ST. LOUIS AND CINCINNATI					
Consolidated L. & Z.	Lead, zinc	Tri-State	4⅛	3⅛	3⅛
Eagle-Picher	Lead, zinc, silver	Various	10	8.00	8.00
Eagle Picher, pfd.	Lead, zinc, silver	Various	101	101	101
SAN FRANCISCO, LOS ANGELES, AND COLORADO SPRINGS					
California Copper	Copper, gold, silver	California	1.87½	1.00	1.25
Golden Cycle	Gold	Colorado	14.75	13.50	14.75
Idaho-Maryland	Gold	California	0.24	0.19	0.22½
Portland	Gold	Colorado	0.01⅞	0.01⅛	0.01⅛
Tom Reed	Gold	Arizona	0.75	0.53	0.70
United Gold	Gold	Colorado	0.09⅛	0.08⅛	0.08⅛
SPOKANE					
Constitution	Lead, zinc, silver	Idaho	0.31	0.10	0.10
Dayrock	Lead, silver	Idaho	1.85	1.05	1.25
Golconda	Lead, zinc, silver	Idaho	1.00	0.51	0.58
Grandview	Zinc, lead	Wash	0.07⅛	0.04⅛	0.04⅛
Highland-Surprise	Lead, silver	Idaho			0.06*
Jack Waite Con	Lead, zinc, silver	Idaho	0.08⅛	0.07	0.07⅛
Lucky Jim	Lead, zinc	Brit. Col.			0.05*
Mexican Premier	Lead, silver, gold	Mexico	0.63	0.28	0.32
Montana Mines	Gold, silver	Montana	0.54	0.28	0.30
Noble Five	Lead, zinc	Brit. Col.	0.09⅛	0.06	0.06
Pend Orielle	Zinc, silver, lead	Wash	1.50	0.90	1.00
Ruth Hope	Lead, silver	Brit. Col.			0.14*
Sherman Lead	Lead, silver	Idaho	0.50⅛	0.40	0.40
Silversmith	Lead, silver	Brit. Col.			0.05*
Sunshine Mining	Silver, lead, copper	Idaho	2.40	1.48	1.48
Tamarack & Custer	Lead, silver	Idaho	0.41⅛	0.32	0.32½
Whitewater	Lead, silver	Brit. Col.			0.15*
SALT LAKE CITY					
Chief Con	Lead, silver, gold	Utah	1.05	0.90	1.05
Combined Metals	Zinc, lead, silver	Various	0.10⅛	0.09	0.09
Eureka Bullion	Lead, silver, gold	Utah	0.22	0.14½	0.22
Eureka Lilly	Lead, silver, gold	Utah	0.50	0.30	0.40
Moscow Silver	Silver, lead	Utah	1.10	0.71	0.71
New Quincy	Lead, silver, zinc	Utah	0.36	0.11	0.15
North Lily	Lead, silver, gold	Utah	1.25	0.65	0.99
Park Bingham	Lead, zinc, silver	Utah	0.05	0.04½	0.04½
Park City Con	Lead, zinc, silver	Utah	0.35	0.29	0.35
Rico Argentine	Zinc, lead, silver	Colorado	0.10	0.07	0.07½
Silver King Coal	Lead, silver, zinc	Utah	9.00	6.75	6.95
Tintic Lead	Lead, silver, copper	Utah	1.25	0.60	1.00
Tintic Standard.*	Lead, gold, silver	Utah	6.25	4.35	5.00
Walker Mining	Copper, gold, silver	California	2.72½	1.80	1.97½
‡LONDON					
Anglo American	Holding	Various	26/9	20/—	23/9
Aramayo Mines	Tin, bismuth, silver	Bolivia	32/6	22/6	25/—
Burma Corporation	Lead, silver, zinc	India	13/1½	10/2½	11/4½
Bwana M'Kubwa	Copper	Rhodesia	18/4½	12/—	14/4½
Camp Bird	Holding	Various	9d	4½d	7½d
Fresnillo	Silver, lead, zinc	Mexico	12/6	12/6	12/6
Frontino & Bolivia	Gold	Colombia	6/6	6/3	6/3
Lake View & Star	Gold	Australia	13/—	11/—	12/3
Mexican Corporation	Copper, zinc	Mexico	6/—	4/6	5/—
N'Changa Copper	Copper	Rhodesia	86/3	43/9	58/9
Oroville Dredging	Gold	California	2/6	1/1½	1/6
Rhodes. Congo Border	Copper	Rhodesia	417/6	275/—	310/—
Rhodes.-Select. Trust	Copper	Rhodesia	49/—	30/3	37/6
Rio Tinto	Copper, pyrites	Spain	814/9	650/—	700/—
St. John del Rey	Gold	Brazil	17/1½	16/—	16/6
San Francisco Mines	Zinc, lead, silver	Mexico	19/9	15/9	17/—
Santa Gertrudis	Silver, gold	Mexico	9/6½	7/4½	8/9
Selukwe	Holding	Africa	4/—	2/6	3/1
So. American Copper	Copper	Venezuela	1/9	1/1½	1/3
Tanganyika	Holding	Africa	45/6	33/6	36/3
Wiluna Gold	Gold	Australia	18/3	17/—	17/6
Union Minière	Copper	Bel.Congo	8,300	7,660	7,810

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